Draft Environmental Impact Report
89.122E

Earthquake Hazard Reduction in Unreinforced Masonry Buildings: Program Alternatives

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City and County of San Francisco Department of City Planning

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TO: Distribution List for the UMB Program Alternatives Draft EIR

FROM: Barbara Sahm, Environmental Review Officer

SUBJECT: Request for the Final Environmental Impact Report for the UMB Program Alternatives

This is the Draft of the Environmental Impact Report for the UMB Program Alternatives. A public hearing will be held on the adequacy and accuracy of this document. After the public hearing, our office will prepare and publish a document titled "Summary of Comments and Responses" which will contain a summary of all relevant comments on this Draft EIR and our responses to those comments. It may also specify changes to this Draft EIR. Those who testify at the hearing on the draft will automatically receive a copy of the Comments and Responses document along with notice of the date reserved for certification; others may receive such copies and notice on request or by visiting our office. This Draft EIR together with the Summary of Comments and Responses document will be considered by the City Planning Commission in an advertised public meeting and certified as a Final EIR.

After certification, we will modify the Draft EIR as specified by the Comments and Responses document and print both documents in a single publication called the Final Environmental Impact Report. The Final EIR will add no new information to the combination of the two documents except to reproduce the certification resolution. It will simply provide the information in one rather than two documents. Therefore, if you receive a copy of the Comments and Responses document in addition to this copy of the Draft EIR, you will technically have a copy of the Final EIR.

We are aware that many people who receive the Draft EIR and Summary of Comments and Responses have no interest in receiving virtually the same information after the EIR has been certified. To avoid expending money and paper needlessly, we would like to send copies of the Final EIR to private individuals only if they request them.

If you want a copy of the Final EIR, please so indicate in the space provided on the next page and mail the request to the Office of Environmental Review within two weeks after certification of the EIR. Any private party not requesting a Final EIR by that time will not be mailed a copy. Responsible agencies on the distribution list will automatically receive a copy of the Final EIR.

Thank you for your interest in this project.

Earthquake hazard
reduction in
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REQUEST FOR FINAL ENVIRONMENTAL IMPACT REPORT

TO: Department of City Planning, Office of Environmental Review

RE: UMB Program Alternatives Final EIR (89.122 E)

(_____) Please send me a copy of the UMB Program Alternatives Final EIR.

Signed: ____________________________________

Print Your Name and Address Below:

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EARTHQUAKE HAZARD REDUCTION IN UNREINFORCED MASONRY BUILDINGS: PROGRAM ALTERNATIVES

DRAFT ENVIRONMENTAL IMPACT REPORT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. SUMMARY

A. PROJECT DESCRIPTION

The project under review consists of five alternative approaches to reducing the earthquake-related life safety hazards associated with approximately 2000 privately owned unreinforced masonry buildings (UMBs) located throughout San Francisco. These are buildings with load-bearing walls constructed of masonry that is insufficiently reinforced with steel to resist the lateral forces associated with earthquakes. Depending on whether a program is adopted by the City and on which approach is selected, the project has the potential to affect 21,800 residential units, 5400 designated tourist hotel units, and approximately 4500 businesses. In addition, about 50 buildings used for public assembly purposes (e.g. churches, private schools and theatres) could be affected. The City's objective is to reduce the earthquake related life safety hazards of UMBs--in buildings, on the street and to occupants of neighboring properties--while minimizing hardships for owners and occupants of these buildings.

1. AREAS OF CONTROVERSY AND ISSUES TO BE RESOLVED

The primary areas of controversy pertaining to the project include whether the costs of UMB seismic retrofit justify the benefits; whether money spent to strengthen UMBs could be used to save more lives if spent on other options such as strengthening freeways and bridges, improving emergency fire-fighting capabilities, improving the City's general emergency response capabilities, etc.; whether the demonstrable reduction of UMB earthquake losses (including lives saved, buildings saved, and lesser disruption and dislocation) outweighs expected mandatory program-induced losses (demolitions) of buildings (including housing units and commercial space) and disruption and dislocation of building tenants; whether a retrofit program can be carried out with minimum adverse effects on architecturally and historically significant UMBs; whether retrofit of UMBs would help save the buildings as well as save

lives; who would bear the costs of a UMB retrofit program and who would gain the benefits; what should be the timeframe to strengthen all UMBs if a mandatory program is selected; what priority system should be used to determine the order in which UMBs would be given notices to retrofit.

All of the above major areas of controversy constitute issues to be resolved by the Board of Supervisors in deciding upon a course of action with respect to seismic hazards of UMBs. This Environmental Impact Report and a companion socioeconomic impact report /1/ have been prepared by the Department of City Planning to help provide information for decision-making in light of the controversial issues involved.

2. BACKGROUND

In 1988, a United States Geological Survey (USGS) working group estimated that there is a 50 percent probability that a major earthquake--larger than Richter Magnitude (R) 7.0--will occur on a fault segment as close as nine miles to downtown San Francisco, on the northern San Andreas or Hayward fault, before the year 2018. In July of 1990, this group publicly announced results of recent work that increased the estimated probability to 67%, or 2:1, for such an earthquake within the next 30 years./2/

In an earthquake, deaths and major injuries are caused primarily from the failure of existing structures (such as highways, buildings and dams) that are vulnerable to earthquake forces. Unreinforced masonry buildings in San Francisco are mostly of brick construction with little or no steel reinforcement to resist side-to-side (lateral) motions of earthquake forces. UMBs in particular have performed poorly in every damaging California earthquake and a large number of them will have some degree of life-threatening failure in a major earthquake.

Recognizing both the impending earthquake threat and the danger posed by unreinforced masonry buildings, the Board of Supervisors, in 1981, directed the City's Seismic Investigation and Hazard Survey Advisory Committee to

recommend a program to improve the earthquake safety of the privately owned UMBs in San Francisco. By 1986 the City's Bureau of Building Inspection (BBI) identified a working list of approximately 2000 UMBs and, in 1987, notified the building owners that their buildings were considered to be of unreinforced masonry. The Chief Administrative Officer then formed a UMB Citizens Advisory Committee (CAC) and a UMB Task Force to define the local issues involved and begin to develop a set of recommendations that may include a comprehensive program to reduce the hazard that UMBs pose to public safety. The Board of Supervisors will ultimately decide whether to adopt a program.

3. ALTERNATIVES

This EIR analyzes the effects of five alternative approaches to reducing the earthquake hazard associated with these buildings, of which three involve mandatory retrofit of UMBs to different levels of strengthening. The five alternatives were selected to encompass the range of programs being considered feasible for adoption by the City, as expressed by the UMB Task Force and CAC. The Alternatives are not necessarily mutually exclusive and a combination of features from different EIR Alternatives could be adopted.

Briefly, Alternative A is "no project" (no program beyond those already in effect). Alternative B is a "voluntary retrofit" program that would not mandate retrofit but may require, for example, an engineering study and retrofit cost estimate to be performed and made public for each UMB. Alternative C is a mandatory retrofit requirement consisting of anchoring walls to floors and roof, plus installation of wall supports to reduce out-of-plane wall failures. Alternative D is a mandatory retrofit requirement which reflects current practice in Los Angeles in retrofitting buildings under a mandatory UMB retrofit ordinance in effect since 1981. The particular approach analyzed in Alternative D is taken from a proposed amendment to the Uniform Code for Building Conservation (UCBC). Alternative E is the mandatory application of Section 104(f) of the San Francisco Building Code (SFBC), seismic strengthening that is currently triggered in any older building when substantial addition, alteration, or intensification of use is proposed.

a. Alternative A: No Project.

Under this alternative, existing programs to increase life safety and to upgrade emergency response would continue at their present level and pace. These efforts include: enforcement of the Citywide parapet abatement ordinance; the Earthquake Safety Program (an effort to reduce earthquake vulnerability in City-owned buildings); the existing San Francisco Building Code (SFBC) requirement (Section 104(f)) that all buildings be structurally strengthened to 1973 Uniform Building Code (UBC) levels for new construction if a change of use intensity or substantial building remodel or expansion is proposed; and emergency preparedness efforts by the Mayor's Office of Emergency Services, the Fire Department and other departments. In addition, the Bureau of Building Inspection (BBI) has notified UMB owners that their buildings are on a UMB inventory list. BBI would maintain its working list of identified UMBs for public inspection.

b. Alternative B: Voluntary Program.

Conceptually, this program would provide resources to develop a program to encourage voluntary upgrade (to the level of SFBC, Section 104(f)). Though not specifically defined at this time, such a program could include an informational program and an owner duty to inform building occupants and prospective buyers of suspected weaknesses in the building. An owner may also be required to submit to the City an engineer's strengthening plan, including a cost estimate, so that a prospective buyer would be alerted. No retrofit of buildings would be specifically required by the City under this Alternative.

c. Alternative C: Anchorage and Interconnection.

Under this alternative, a relatively low level of retrofit strengthening would be mandated for UMBs. Strengthening activities would be limited to those which anchor unreinforced masonry walls to floors and roofs, and, as warranted, measures intended to prevent walls from collapsing perpendicular to their length ("out-of-plane") would be required. Typically such work is

confined to the perimeter walls, although larger buildings may have interior unreinforced masonry walls that must be similarly strengthened.

Retrofit projects under this alternative would generally be considered small. Costs would vary from less than $20,000 in small uncomplicated projects and rarely exceed $175,000 for the larger projects. This level of retrofit can normally be done with occupants in place, although five to ten day temporary relocations within a building may be needed in many cases. Total construction time per building would vary widely but is generally proportional to building size and construction cost. For buildings with occupants in place, the typical range is 5-16 weeks.

d. Alternative D: Proposed Uniform Code for Building Conservation (UCBC-Draft Number 7).

Under this alternative, which is essentially comparable to current practice in Los Angeles, a relatively moderate level of retrofit strengthening would be mandated for UMBs. The wall anchors and possible out-of-plane strengthening required by Alternative C would usually have to be supplemented by strengthening of other building elements including diaphragms (floors and roofs) and walls themselves. A substantial increase in construction activity is generally required compared with Alternative C. Costs would vary from $25,000 for small vacant buildings to over $1 million for very large UMBs.

While it is technically feasible to keep most buildings occupied during construction, there may be considerable inconvenience and disruption to occupants and the retrofit work flow would be less efficient and more costly. Disruption would vary depending on building use and configuration. Total construction time per building would vary widely, depending on factors which include the amount of work needed, building size, and whether the work is done with occupants in place. Smaller projects in unoccupied UMBs would tend to take 2-3 months, with the larger and more complex projects taking 3-6 months. With occupants in place, projects would tend to take 3-12 months.

e. Alternative E: San Francisco Building Code, Section 104(f).

Under this alternative, a relatively high level of retrofit strengthening would be required for UMBs, usually representing a substantial escalation in construction compared with Alternatives C and D. Typically, structural steel or concrete would be utilized and new foundations would often be needed. Average costs would be about $250,000, with the smallest buildings averaging about $35,000 if vacant, and the larger projects exceeding $1 million in most cases.

More buildings would be expected to vacate occupants under this alternative, due to the highly disruptive kinds of work required. Project duration for vacant buildings would typically be two months for the smaller projects, 3-4 months for medium size projects, and 6-8 months for larger projects for vacant buildings. Compared with vacant buildings, time needed to retrofit with occupants in place would be about 25-50% more for industrial uses, 70-100% more for commercial uses, and 100% more for residential buildings.

B. ENVIRONMENTAL IMPACTS

The alternative programs being considered were developed in recognition of the Bay Area's increasing risk of damaging earthquakes and the scientific expectation of disproportionate life loss and disability due to the structural failure of buildings with bearing walls constructed of unreinforced masonry. Three (possibly four) of the five alternatives would involve amending the San Francisco Building Code, and three would mandate that UMBs be structurally strengthened or demolished to reduce the potential for occupant and pedestrian life loss and severe injury in a damaging earthquake. None of the alternatives proposes a specific construction project that would generate environmental impacts. However, in response to a City requirement that UMBs be strengthened, construction activities with the potential to cause some impacts would occur. Furthermore, in light of retrofit costs, some building

owners might choose to redevelop their properties in ways that could result in impacts. Such owner choices may include temporary building closure and complete renovation; conversion to another, more profitable use; building demolition without replacement (eg. parking lot use); and demolition with replacement (of same or different uses and use intensities). These owner choices were evidenced in the City of Los Angeles over the past nine years in response to a Los Angeles Building Code amendment that is quite similar to Alternative D. It is also possible that some buildings may ultimately be abandoned, having insufficient foreseeable economic value to support the cost of retrofit or demolition.

The indirect nature of the relationship between a change in a building code and development impacts, combined with the unpredictability of other development factors, do not lend themselves to a sharply defined impact assessment. However, based on the above considerations, this EIR does provide estimates of the amount and type of development that could reasonably be expected to occur over a ten-year timeframe with and without a requirement to strengthen the UMBs. In addition to this program-level assessment, this EIR also discusses temporary, short-term impacts that would be associated with structural strengthening construction activities and the potential effect of retrofit on UMB architecture. Expected casualties and damage from UMBs associated with each alternative are also estimated. Summary conclusions based on the EIR impact assessment follow.

1. Program-Induced Development

Owners' decisions about their buildings, with or without a retrofit program, have environmental implications, particularly for longer-term loss of housing units and resulting residential displacement; loss of existing commercial space and resulting employment displacement; potential growth inducement through program-induced demolition of UMBs and replacement new construction of larger buildings; and potential loss of architecturally significant buildings. To assess the general magnitude of these potential impacts, an economic analysis was carried out to estimate building outcomes

over the next 10-30 years, both without a UMB retrofit program (Alternative A, "no project," or "base case") and under the three mandatory retrofit EIR alternatives C, D, and E. This analysis is briefly discussed below as background to subsequent discussions of various "program-induced development" impacts.

The potential for program-induced changes in UMBs or UMB site use through demolitions or conversions was estimated for existing, unstrengthened UMBs and for UMBs strengthened to each of the three mandated retrofit alternatives by Recht Hausrath & Associates, urban economists for the UMB studies./1/ Summarized below are findings from their detailed report, Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings: Socioeconomic and Land Use Implications of Alternative Requirements (RHA 1990), available for review or purchase at the Department of City Planning, 450 McAllister Street, 4th Floor Reception, San Francisco.

Requirements to spend money to complete the seismic retrofitting of a UMB would influence building owner decisions about the longer-term use of their property. Depending on current building occupancies as well as alternative uses for the buildings and their sites, owners of UMBs could decide to either complete the retrofitting work, or undertake the retrofitting project while also converting the building to a higher rent paying use, or demolish the building for new development, or demolish the building and hold or sell the land because compliance with retrofitting requirements would not be economically feasible. In some instances, the UMB would have been converted or demolished for new development in any case, as part of the on-going pattern of land use change in the City. Requirements to retrofit could change a building owner's calculation of what to do with the UMB and when to act.

Five categories were developed to describe longer-term building outcomes for the background economic and land use impact assessment. The categories cover the range of possible building outcomes quantified in this analysis of UMBs. The building outcome scenarios for the base case (Alternative A) and for the three seismic retrofitting alternatives (C, D, and E) are summarized

according to those categories, which are:

- UMB demolished for new construction
- UMB converted or altered, and retrofit to 104(f)
- UMB retrofit according to the particular alternative
- UMB at risk of demolition (unlikely to be retrofitted)
- UMB without retrofit

Table I-1 summarizes the results of the building outcome analysis for all commercial/industrial and residential UMBs. The table shows what would be likely to happen to unreinforced masonry buildings in San Francisco under Alternative A, with no mandatory retrofitting requirements (the base case scenario) except for building conversions or alterations (seismic retrofitting currently required per Section 104(f) of the building code). The table also shows what would be likely to happen to UMBs under each alternative. The estimates are given for a ten year period, the assumed enforcement period (1990-2000).

Through the year 2000, relatively few UMBs would be retrofit under Alternative A (only about three percent of the total). Most of those are buildings that would be converted to higher-rent-paying uses, and therefore would be retrofit according to the requirements of Section 104(f) of the building code. In the expected course of development in San Francisco, a few UMBs would be demolished for new construction between 1990 and 2000 (most of those UMBs are part of downtown projects that already have been approved).

As Table I-1 shows, the number of potential UMB demolitions and conversions under Alternative C would be slightly larger than that expected under Alternative A. Most buildings (90%) would be retrofit per the requirement. About 3% of the UMBs (50 buildings) would fall into the "at-risk" category.

Under Alternative D, somewhat more UMBs would be demolished for new construction or converted to other uses sooner than under (Alternative A) or

TABLE I-1

RESIDENTIAL AND COMMERCIAL UMB
BUILDING OUTCOMES, BY ALTERNATIVE

Shorter term outlook: 1990-2000

Number of buildings (and percent of all 1,959 residential & commercial UMBs)

BUILDING OUTCOME (10 yrs.)	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Demolition/New Construction	48 (3%)	*	61 (3%)	75 (4%)	93 (5%)
Retrofit/Conversion of Use[a]	65 (3%)	*	86 (4%)	101 (5%)	136 (7%)
Retrofit per Alternative	NA	*	1762 (90%)	1651 (84%)	1333 (68%)
At Risk of Demolition[b]	NA	*	50 (3%)	132 (7%)	397 (20%)
Without Retrofit	1846 (94%)	*	NA	NA	NA
Total	1959	1959	1959	1959	1959

Longer term outlook: Totals in 2020

Number of buildings (and percent of all 1,959 residential & commercial UMBs)

BUILDING OUTCOME (30 yrs.)	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Demolition/New Construction	161 (8%)	*	162 (8%)	166 (8%)	178 (9%)
Retrofit/Conversion of Use[a]	127 (7%)	*	127 (7%)	129 (7%)	164 (9%)
Retrofit per Alternative	NA	*	1628 (83%)	1542 (79%)	1240 (63%)
At Risk of Demolition[b]	NA	*	42 (2%)	122 (6%)	377 (19%)
Without Retrofit	1671 (85%)	*	NA	NA	NA
Total	1959	1959	1959	1959	1959

Source: RHA 1990

NA = Not Applicable

* Alternative B numbers would fall between those of Alternative A and Alternative E, most likely close to Alternative A.

SEE TOP OF NEXT PAGE FOR TABLE NOTES

[a] UMBs converted to another use or with additions or substantial alterations that trigger seismic retrofitting requirements per Section 104(f) of the current San Francisco Building Code.

[b] UMBs at-risk eventually would be demolished. In the absence of economic assistance, they are unlikely to be retrofit, given the high costs of retrofitting relative to building value.

NOTES:

The 48 UMBs with institutional uses are not included in this assessment. Institutions are generally not subject to purely economic development forces and are too individualistic to predict future outcomes of their buildings.

The numbers for Alternative A represent a "Base Case" which is forecast to occur with no UMB program or regardless of any program which may be adopted.

The numbers given are subject to errors due to uncertainties of forecasting; however the relationships among alternatives should be generally consistent and valid.

Alternative C. More UMBs would be at-risk with the retrofitting requirements of Alternative D, compared to Alternative C, a total of 7% of all commercial and residential UMBs. About 84% of the buildings would be retrofit per this Alternative, and another 9% would be demolished for new construction or retrofitted to 104(f) through conversion or alteration.

Under Alternative E, there would be almost twice as much demolition for new construction between 1990 and 2000 as there would be under Alternative A. There would be more than twice as much program-induced conversion and alteration, because Section 104(f) seismic upgrading standards would be required in any case under this Alternative. About 20% of the UMBs would be at-risk of eventual demolition as a result of Alternative E retrofitting requirements. About two-thirds of the buildings would be retrofit in response to the requirements by the year 2000.

Most of the UMBs estimated to be demolished for new construction or converted/altered and retrofit to 104(f) under Alternatives C, D, and E would

have undergone the change in the longer term (2000-2020) under Alternative A. The various mandatory retrofit programs would, in most cases, induce these changes sooner.

2. Growth Inducing Impacts

Adoption of a UMB program could indirectly generate growth depending upon owner decisions when faced with the costs and other factors associated with a retrofit requirement. In this context, growth inducement would occur through two potential changes: new construction (either after UMB demolition or in an addition to an existing UMB) and conversions of use (for example, from warehouse to office). To examine growth potential, the UMB data base was analyzed in conjunction with analysis of existing locational and land use market factors and land use regulations in an attempt to forecast the building outcomes that could reasonably be expected under the various alternatives.

The assessment indicates that the number of conversion and demolition/new construction building outcomes would increase from Alternative A through Alternative E, though the total number of buildings in all cases is fairly small in the shorter term (10 years), about 25 buildings (1% of all UMBs) under Alternative C, about 47 buildings (2% of UMBs) under Alternative D, and about 116 buildings (6% of UMBs) under Alternative E. These changes would occur over a period of about 10 years, in scattered locations throughout the city. Most of these changes would have occurred anyway in the longer term (30 years, by the year 2020); a retrofit program would merely hasten the timing of this new development, as buildings which would have been redeveloped, say, 15 years from now will be redeveloped sooner, when faced with a notice to retrofit. In this longer term outlook, very few buildings would have program-induced growth outcomes (four buildings under Alternative C, 11 buildings under Alternative D, and 59 buildings under Alternative E). Most of these buildings would undergo conversions of use, rather than demolition for new construction.

As was shown in Table I-1, the number of potential program-induced building losses (buildings at risk of demolition without replacement) exceeds the number of growth inducing building outcomes, particularly in the longer term (30 years). In light of the potential net loss of building space, and the small amount of development potential generated by any of the program alternatives, it is concluded that the growth inducing effect of any of the alternatives or combinations thereof would be minor, and no significant growth-associated impacts on transportation, air quality, or other environmental factors measurable in the overall program context of this analysis are foreseeable under any of the alternatives or possible combinations of alternatives.

3. Displacement due to Retrofit Construction

Displacement of both existing residential and business occupants of UMBs can be expected under the various alternatives. Displacement would be caused by (1) retrofit construction due to vacating of buildings for construction work and (2) redevelopment, demolition, or conversion of UMBs due to owner decisions leading to certain building outcomes, as described in the previous section. Both types of displacement are discussed below.

a. Residential Displacement

Of the approximately 19,900 multifamily residential buildings in San Francisco, about three percent (658) are UMBs. However, the UMBs contain approximately 10% of the 215,000 multifamily units in the city. In addition, there are 130 UMB single family homes and UMBs containing one or two flats or condos. The UMBs contain approximately 21,800 residential units and an additional 5400 units classified by BBI's Division of Housing Inspection as tourist hotel units, often in buildings with a mixture of residential and tourist units.

(1) Alternatives A and B. There is little potential for substantial residential displacement associated with either Alternative A or B. The

voluntary retrofit construction activities associated with Alternatives A and B are expected to be at the level of current SFBC, Section 104(f) (Alternative E level). Since these projects would be undertaken at owner discretion, the rate of undertaking and the types of buildings involved are assumed to be similar to those that are currently witnessed for Alternative A (two to three annually) and only slightly higher numbers for Alternative B. Most have been done without involuntary displacement of occupants.

(2) Alternative C. Alternative C would involve mandatory retrofit of all UMBs, but with much less construction than that necessary for retrofit under Alternatives A, B, D, or E. The extent of disruption, discomfort and inconvenience to some tenants affected by Alternative C would vary according to quality of design, planning and execution of a particular retrofit project, but displacement from buildings would normally not be necessary or expected. Because of their need for rent revenues, landlords are generally not expected to vacate buildings . It is possible that some tenants who reside in small units or particularly small buildings would be asked to use another unit in the building (accrued vacancies set aside for this purpose) for a few days while the work is phased through units to which construction access is needed. Many units would not directly be affected under Alternative C although persons remaining in place during the work would be disturbed by noise, dust and work activity.

(3) Alternative D. Construction could cause residential tenants in approximately 16% of the units in UMBs (about 3400 units) to be legally evicted for periods ranging from one to three months over the course of the compliance period (five to 30 years). While they would have the right to return to their units, it is assumed that many would not do so. Based on similar circumstances in the Los Angeles UMB retrofit program, many of these tenants would relocate to smaller quarters that have fewer amenities at comparable rents. At the same time, program-related demand due to retrofit-related construction under this alternative is not expected to lead to the need for new residential construction even in the shortest (five year) compliance timeframe because of generally expected availability of units due

to normal vacancy rates and return of retrofitted units to the market. Consequently, impacts related to both tenant and housing unit displacement, while of social concern (hardships to individual tenants could occur), are not considered substantial from an environmental review perspective.

(4) Alternative E. Over the course of a five to 30 year program compliance period, Alternative E construction activities could result in temporary evictions from approximately 40% of the residential units in UMBs for periods ranging from two to six months. Of the approximately 11,400 units that would need to be emptied (excluding tourist units), about 2600 would result from normal or accrued vacancies. Approximately 7200 would result from entire buildings being vacated in order to perform the work. It is unlikely that available housing could accommodate this number of displaced people at comparable rents, particularly if the program compliance period is 10 years or less. Because of the substantial number of persons involved, and because the length of construction time during which tenants would be displaced is generally longest of the Alternatives, this impact is considered significant. The balance of units that would need to be emptied during the work (approximately 1500 units) would be located in the larger buildings where the retrofit activities could be performed in empty building quadrants. Tenants would likely be moved within the buildings to completed units. It is expected that most owners of these large residential buildings would choose this approach in order to maintain the maximum possible income stream during the relatively lengthy construction period.

b. Employment Displacement.

There are an estimated 46,000 jobs provided by the approximately 4500 businesses and institutions located in UMBs, representing about 8% of the 592,000 total jobs in San Francisco. Although retrofit with occupants in place is technically feasible under any of the alternatives, it is estimated that, depending on the level of retrofit required, some buildings would be totally emptied and most others would be partially vacated through attrition of tenants accumulated specifically in advance of scheduling construction

work. Employment displacement impacts for each alternative are described further below.

(1) Alternatives A and B. For the same reasons discussed previously for residential displacement, there is little potential for these alternatives to cause substantial employment displacement. Under Alternative A there would be no mandate to strengthen UMBs to better withstand earthquake forces, so it is expected that few (two to three per year) UMBs would be strengthened. The level of strengthening that would occur would generally be quite disruptive, but relatively few buildings would be affected. Generally such work is expected to occur at the normal termination of commercial leases. Displacement of businesses during the construction work would be for periods of 6 to 12 months.

(2) Alternative C. The level of disruption expected with Alternative C work would not, in most cases, require that a building be vacated. The work could be disruptive for a few weeks to a few months but the extent and duration of disruption to occupants of individual buildings would be the least of all five alternatives. Dislocations are generally not expected unless the owner elects to do additional work to remodel or renovate at the same time that retrofit work must be done.

(3) Alternative D. The smallest UMBs are expected to be vacated for one to three months during the construction activities associated with this alternative. In those UMBs that are not vacated entirely, short-term business closure may be necessitated for one to two weeks or relocation within the building may occasionally be necessitated but major dislocation would not be expected. If all 623 UMBs with small plate size were to be vacated then approximately 1000 businesses (20-25% of the businesses in UMBs) would be involved. These 1000 businesses are estimated to employ about 5000 people.

An average of 200-250 businesses would need to temporarily close or relocate per year with the shortest, five-year compliance period, dislocating approximately 1250 employees annually, less than one-fifth of one percent of

the jobs in San Francisco. For longer term programs, the annual dislocations would be proportionately fewer.

(4) Alternative E. About 1700 businesses employing about 8500-9000 people could be displaced for retrofit construction. With a five-year program, an annual average of approximately 425 businesses providing about 2200 jobs could be temporarily displaced for periods ranging from two to six months. In most cases, it is likely that displaced businesses would need to relocate permanently. For longer term programs, the annual dislocations would be proportionately fewer. The number of jobs subject to displacement annually represents less than one-half of one percent of San Francisco jobs.

c. Institutional Displacement.

Forty-eight of the UMBs are classified as institutional uses (two hospital accessory UMBs, 32 religious uses, three residential care facilities, and 11 private school/day care uses). Of the 14 UMBs that contain schools (three in churches), 10 serve elementary school children (approximately 2800 students), two are senior high schools serving 180 students, one serves 40 students in vocational training and one serves 90 pre-school children.

Few institutions would be subject to temporary dislocation to other buildings during construction, although some churches could need alternative meeting spaces during retrofit work under Alternatives D and E, and for those remaining in place, construction would need to be carefully scheduled to enable reasonably normal operations.

While not quantified, it is expected that under Alternatives C, D, and E, respectively, increasing numbers of institutions would be dislocated from their present UMB space due to inability to pay the costs of retrofit. Churches and schools, in particular, would probably sell their UMBs and relocate in such circumstances. Certain long-established religious uses of historic church buildings could be adversely affected, and the buildings placed at risk of demolition.

4. Displacement due to Program-Induced Development.

Based on the longer-term, program-induced building outcomes shown in Table I-1, the following subsections discuss expected residential and employment displacement that could result under each alternative, compared with housing and commercial space "saved" from earthquake damage.

a. Residential Displacement.

Table I-2 shows the estimated number of units in residential buildings (excluding tourist hotel units and the few units located in commercial buildings) that could be subject to demolition or conversion under each alternative.

TABLE I-2

ESTIMATED LOSS OF EXISTING RESIDENTIAL UNITS
DUE TO PROGRAM-INDUCED DEVELOPMENT, BY ALTERNATIVE

	Number of Units (and Percent of UMB Units)[a]		
	Alt. C	Alt. D	Alt. E
BUILDING OUTCOME	No. (%)	No. (%)	No. (%)
Demolished or Converted	129 (<1%)	691 (3%)	1,321 (6%)
At risk of Demolition without Replacement	78 (<1%)	1,941 (9%)	9,914 (46%)
TOTAL UNITS AFFECTED	207 (1%)	2,632 (12%)	11,235 (52%)

Source: RHA 1990

a Based on the total number of residential UMB units (21,755), which excludes the small number of units located in predominately commercial buildings.

City zoning controls and policies designed to protect the existing housing stock would limit development options open to owners of residential UMBs. Residential units in San Francisco are protected by a variety of ordinances and policies. Consequently, demolition/new development or conversion of residential UMBs under any of the alternatives would be limited.

Because the cost of retrofitting many residential UMBs would be high relative to expected rental income, and because development options are more limited for these buildings, as discussed above, substantial numbers of residential UMBs would be at risk of eventual demolition, particularly under Alternatives D and E. About 1% of UMB residential units would be at risk of demolition under Alternative C. Under Alternative D, 12% of the units would be at risk with the South of Market, North of Market, and Chinatown areas having relatively high concentrations. Under Alternative E, one-half of the units would be at risk, including a substantial majority in the North of Market area and parts of South of Market.

Although increasing levels of strengthening would lead to progressively more housing units lost, such losses must be balanced against housing "saved" from future earthquake destruction. Engineering research estimates of UMB earthquake losses under Alternatives A, C, D, and E have been made specifically for the purpose of UMB alternatives analysis. These estimates were made both on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), and for scenario earthquakes of 7.0 on the northern Hayward Fault and 8.3 on the northern San Andreas Fault. The annual loss estimates provide the most rational method to factor in the uncertainties as to precisely when damaging earthquakes might occur. Expressing losses on an expected annual basis provides the statistical ability to determine how long it would probably take for the buildings saved by the various retrofit alternatives to equal and surpass the program-induced building losses. Expressing losses in a scenario, however, tends to be more understandable.

The engineering research work indicates that retrofit would "save" from earthquake loss, on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), 112 residential units annually under Alternative C, 139 under Alternative D, and 148 under Alternative E. When balanced against the program-induced residential unit losses discussed above (and shown in Table I-2), Alternative C strengthening would save from expected earthquake loss as many units as it

could lead to demolition in about two years. Under Alternative D, it would take about 19 years for the expected units lost to demolition to balance the expected units saved from earthquake loss, and under Alternative E, it would take about 76 years.

In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, about 3170 residential units would be lost under Alternative A, 480 under Alternative C (= 2690 units "saved"), 155 under Alternative D (= 3015 "saved"), and 50 under Alternative E (= 3120 "saved"). Given such an earthquake (considered the most likely scenario to occur over the next 30 years), Alternative C would save about 13 times as many units (a net of about 2500 units) as it would put at risk of demolition due to its cost (as given in Table I-2), Alternative D would save roughly 600 more than would be lost, and Alternative E would generate program-induced losses 3-4 times greater than it would save (representing a net loss of about 8,000 units, a significant loss of housing stock).

b. Employment Displacement

Table I-3 shows the number of businesses potentially displaced by program-induced development, redevelopment or demolitions.

Under Alternative C, about two percent of all businesses in UMBs would be subject to displacement; under Alternative D, six percent, and under Alternative E, about 19%.

Retrofit would "save" from earthquake loss, on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), building space containing 44 businesses annually under Alternative C, 56 under Alternative D, and 59 under Alternative E. When studied in comparison with the program-induced business displacement shown in Table I-3, it can be seen that Alternative C strengthening would save from expected earthquake displacement as many businesses as could be displaced due to program-generated demolition in about 2-3 years. Under Alternative D, it

TABLE I-3

DISPLACEMENT POTENTIAL FOR BUSINESSES DUE TO PROGRAM-INDUCED DEVELOPMENT, BY ALTERNATIVE

	Number and Percent by Alternative		
	C	D	E
BUILDING OUTCOME	No. (%)[a]	No. (%)[a]	No. (%)[a]
Demolition/new construction	21 (<1%)	40 (<1%)	76 (2%)
Upgrades/conversions	14 (<1%)	20 (<1%)	85 (2%)
At risk of Demolition Without Replacement	68 (2%)	202 (4%)	701 (16%)
TOTAL BUSINESSES AFFECTED	103 (2%)	262 (6%)	862 (19%)

Source: San Francisco Department of City Planning, based on RHA 1990

(a) Percentage based on 4500 businesses in UMBs. Total percentages will not necessarily match due to rounding to nearest whole number.

would take about 4-5 years for the expected businesses displaced by earthquakes to balance the expected number saved from earthquake displacement, and under Alternative E, it would take about 15 years.

In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, about 1445 businesses would be displaced under Alternative A, 330 under Alternative C (= 1115 businesses "saved" from displacement), 70 under Alternative D (= 1375 "saved"), and 30 under Alternative E (= 1415 "saved). Given such an earthquake, Alternative C would save from earthquake displacement about 11 times as many businesses as it would put at risk of displacement due to program-induced development, Alternative D would save roughly five times as many as it would displace, and Alternative E would save about one and one-half times as many as it would displace.

5. Geology/Earthquake Hazards

The damage to San Francisco UMBs and resulting deaths and major (hospitalized) injuries have been estimated for existing, unstrengthened UMBs

and for UMBs strengthened to each of the three mandated retrofit alternatives by Rutherford & Chekene, consulting engineers for the UMB studies./3/ Table I-4 presents the results expressed as annual expected losses considering the estimated probability of all earthquakes from all faults which affect San Francisco. The damage estimates provided in Table I-4 are expressed both as a percentage of building replacement cost and in dollars. Casualties are expressed as number of persons expected to die and number of persons hospitalized with injuries. Also given is the total area and number of buildings expected to sustain sufficient damage to be demolished or not functional for an extended period of time. The same information is presented for specific scenario earthquakes in Section IV.F., on pages IV-71 and IV-72.

Table I-4 shows that, compared with existing unstrengthened buildings, retrofitting all UMBs to the Alternative C level would result in about one-half the deaths and injuries and two-thirds the property damage; Alternative D would result in about one-sixth the deaths and injuries and slightly less than one-half the damage; and Alternative E would result in about one-eighth the deaths and injuries and one-third the damage.

6. Architectural and Historic Resources

a. Construction.

Four retrofit construction activities could result in substantial UMB alterations visible from a building's exterior. In most of these cases, review of construction plans by the City's Landmarks Preservation Advisory Board (LPAB) and City Planning Commission (CPC) would be required or taken on a discretionary basis. The review's purpose would be to seek design or construction alternatives that would eliminate or reduce the extent of exterior alteration incompatible with a building's existing architectural or historic features. Consequently, substantial effects on the City's architectural resources are not expected to result from retrofit construction activities.

TABLE I-4
ANNUAL EXPECTED UMB EARTHQUAKE LOSSES, UMB PROGRAM ALTERNATIVES

All numbers in this table represent the statistical average expected losses in one year from all potential earthquakes affecting S.F.[(a)]

Alternative	Property Losses in %[(b)]	Property Losses in $1,000	Deaths[(c)]	Hospital Injuries	Likely Demolished Sq.Ft.[(d)]	Likely Demolished # Bldgs
A- No Retrofit	1.6%	$46,800	12.6	50.2	419,900	24
B- Voluntary	Not quantified but slightly less than Alternative A					
C- Wall anchors	1.1%	30,900	6.0	23.9	126,100	7
D- UCBC-Draft 7	0.7%	20,700	1.7	6.8	50,000	3
E- Sec. 104(f)	0.6%	15,700	1.1	4.2	31,000	2

Source: Adapted from R & C 1990.

(a) The expected UMB losses in X years equals approximately X times the figures in this table. For example, Alternative A losses in ten years would be ten times greater than these loss and casualty figures. Earthquake caused deaths in or outside San Francisco UMBs are statistically expected to be 126 deaths by the year 2000.

(b) Property loss expressed as a percentage of UMB stock replacement cost.

(c) Includes all UMB-related deaths, both inside and outside the buildings. The number of estimated deaths are thought to be accurate within a factor of 2 at the high end (large earthquake, large number of deaths) and within a factor of 4 at the low end (small earthquake, small number of deaths). However, the relative relationships among the different alternatives are constant and valid for comparative purposes despite these ranges of uncertainty.

(d) The area of UMBs expected to receive damage greater than 40% of replacement cost (50% for strengthened buildings) and therefore considered likely to be demolished or non-functional for considerably longer than normal repair time. Dividing the area as given in square feet by the average UMB size yields a very rough estimate of the number of buildings in this category, given in the last column.

b. Program-induced Development. Certain program-induced building outcomes would affect architectural resources. Most obviously, rated UMBs that are potential candidates for either demolition/new construction or rendered "at risk" of ultimate demolition represent a potential loss of such resources.

Table I-5 summarizes the estimates of the approximate number of UMBs subject to program-induced demolition with or without new construction and identifies the current official protection status.

The Table includes only Alternatives C, D, and E because the effects of program-induced demolitions (both with new development and UMBs at risk to demolition) of UMBs resulting from Alternatives A or B are nominal and would be considered on a case-by-case basis, as warranted by specific circumstances.

Table I-5 indicates that under Alternatives C, D, and E, respectively, increasing numbers of buildings considered to be architectural or historical resources would be at risk of demolition, in most cases due to insufficient value of the building relative to retrofit cost. In such cases, it could be possible for a building owner to demonstrate no remaining economic value in the building, which would allow demolition even under the most stringent current protections for designated buildings. While not quantifiable, it is considered probable that some architecturally and/or historically significant institutional buildings, particularly churches, would be at risk of demolition, particularly due to program costs under Alternatives D and E. It is assumed that some UMBs for which information about architectural merit is lacking would also be demolished, as shown in Table I-5. This information will, however, be available before decisions on these UMBs are needed.

Certain other program-induced building outcomes, such as alterations and additions to the building, could also affect architectural resources. Such potential affects would be moderated by automatic or discretionary review of permit proposals by the LPAB and CPC, as described above for construction permits.

TABLE I-5

ESTIMATED UMB PROGRAM-INDUCED DEMOLITIONS BY ARCHITECTURAL/HISTORICAL PROTECTION STATUS[(a)]

Rating/Protection Category	(Estimated Number of Demolitions) Alter. C		Alter. D		Alter. E	
Year	2000	2020	2000	2020	2000	2020
Buildings surveyed; subject to automatic LPAB/CPC review[(b)]	17	12	54	42	157	134
Buildings surveyed; subject only to discretionary LPAB/CPC review[(c)]	28	18	76	60	210	185
Buildings not yet surveyed (9/90)	18	12	29	20	75	60
TOTALS	63	52	159	122	442	379

Source: San Francisco Department of City Planning and RHA 1990

(a) The 48 UMBs with institutional uses are not included in this assessment. These include a number of rated buildings. Institutions are generally not subject to purely economic development forces and are too individualistic to predict future outcomes of their buildings.

(b) Based on existing Planning Code or Proposition M authority: Comprises City Landmarks; buildings in adopted City Historic Districts; buildings designated Significant or Contributory in Area Plans of the Master Plan; Downtown buildings rated Category I, II, III or IV; Downtown buildings in Conservation Districts rated Category I, II, III, IV or V; buildings rated in the 1976 DCP Architectural Survey; buildings listed or declared eligible for National Register of Historic Places.

(c) Comprises buildings nominated for National Register of Historic Places; buildings in proposed City Historic Districts; buildings designated Not Significant or Contributory in Area Plans of the Master Plan; Downtown buildings rated Category V not in Conservation Districts; buildings rated by Heritage not otherwise protected.

Notes: Program-induced demolitions include demolitions for new construction plus buildings "at risk" of demolition. Most are in the "at-risk" category. The number of buildings in these categories attributable to the program alternatives decreases in the longer term (year 2020) compared with the shorter term (year 2000) because more of these building outcomes would have occurred by then in the base case (Alternative A), with or without a retrofit program.

LPAB = Landmarks Preservation Advisory Board
CPC = City Planning Commission

c. Earthquake Losses. Although increasing levels of strengthening would lead to progressively more buildings lost, such losses must be balanced against buildings "saved" from future earthquake destruction. Retrofit would "save" from earthquake loss, on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), roughly seven architecturally significant buildings annually under Alternative C, and nine under Alternatives D and E. When studied in comparison with the program-induced losses of buildings significant enough to warrant automatic LPAB review of alterations or demolitions as shown in Table IV-20, it can be seen that Alternative C strengthening would save from expected earthquake loss as many such buildings as it could lose to demolition in about two years. Under Alternative D, it would take about 5-6 years for such buildings saved from earthquake loss to balance those demolished due to program costs, and under Alternative E, it would take about 15-18 years.

In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, about 240 such buildings would be lost under Alternative A, 55 under Alternative C (= 185 buildings "saved"), 12 under Alternative D (= 225 "saved"), and 4 under Alternative E (= 235 "saved"). Given such an earthquake (considered the most likely scenario to occur over the next 30 years), Alternative C would provide a "net savings" (depending on when the earthquake might occur in relation to the shorter-term/longer-term program-induced building losses) of about 170 significant buildings, Alternative D would provide a "net savings" of about 170-185 significant buildings, and Alternative E would provide a "net savings" of about 75-100 significant buildings.

C. MITIGATION MEASURES

1. Background

The primary objective of the UMB program alternatives is to reduce life safety risks from earthquakes and related geologic hazards affecting these buildings. Therefore, the project itself is considered a mitigation measure

addressing existing seismic hazards. Alternative A, while consisting of no new course of action, would result in some increase in life safety benefits due to market-induced demolition and replacement and conversion of some UMBs with required retrofit to an Alternative E level. Alternative B would probably achieve slightly higher life safety through incentives for upgrade.

The three mandatory strengthening alternatives C, D, and E would, in order, provide increasing life safety benefits, considerably greater than Alternatives A or B. These alternatives would also tend to reduce future expected earthquake damage to UMBs, resulting in lesser repair costs and fewer UMBs with damage sufficient to warrant demolition. These life safety and building conservation benefits would occur at the expense of some environmental impacts: displacement of existing residents and businesses in UMBs due both to short-term construction needs and longer-term economic impacts of retrofit costs; loss of existing (largely lower-rent) housing units and commercial space due to program-induced demolition or conversion of buildings containing housing; potential loss of buildings of architectural and/or historic merit due to retrofit costs; and construction-related dust and noise affecting building occupants. Alternatives C, D, and E would involve, in order, increasing levels of these impacts.

Two aspects of a UMB program that could mitigate both program impacts and earthquake hazard impacts under any of the mandatory strengthening alternatives are the timeframe for program compliance and priority of buildings to upgrade. Most program-induced impacts would be reduced with a longer timeframe for program and building compliance, because spreading out building upgrade over a longer time period would reduce the amount of dislocations of UMB residents and businesses occurring at any one time. To the extent program compliance is extended, the primary program objective of life safety is compromised, because the likelihood of a damaging earthquake increases in proportion to the timeframe considered.

Program objectives would be better achieved the earlier all UMBs are strengthened. However, a very rapid program timeframe (say, five years or

less to strengthen all UMBs) would exacerbate impacts (and would be particularly disruptive due to possible program-generated shortages of temporary space for UMB residents and businesses during construction). The UMB program ultimately selected should optimize the compliance timeframe to require strengthening of buildings as quickly as possible without generating substantial impacts.

The second aspect of any mandatory UMB program affecting program objectives and impacts is the priority system chosen, which should determine which categories or geographic areas of buildings should be strengthened earliest in order to maximize the probability that the buildings posing the most risk are retrofitted prior to a damaging earthquake.

A third major form of mitigation would be some kind of financial assistance for the cost of retrofit. To the extent the cost burden on UMB owners is reduced, the number of buildings at risk of demolition or conversion would be reduced, which in turn would reduce the potential program-generated loss of dwelling units, commercial space, and historic buildings. Such assistance would be particularly important in reducing the significant program impacts of Alternative E, and the lesser but still noteworthy effects of Alternative D.

2. Specific Mitigations for Program-Induced Construction Impacts

Temporary displacement of UMB residents and businesses during construction under Alternatives D and E is, to some extent, unavoidable. However, if residents and businesses are willing and able to put up with noise, dust, utility interruptions, and other construction-related disruptions, much retrofit under Alternative D and some under Alternative E could occur with occupants in place. Therefore, despite the assumption in the EIR analysis that about one-third of UMBs under Alternative D and one-half under Alternative E would be vacated for construction, it is possible that those persons and businesses which would be most adversely affected by temporary relocation (or, in the case of some businesses, closure) could

choose to remain during construction.

To lessen the adverse effect of residential displacement, the UMB program should avoid citing for retrofit work a large number of dwelling units at once. Citations for mandatory retrofit work should be planned with consideration of availability of relocation dwelling units and commercial space in mind, and to avoid unnecessary geographic concentrations of relocation needs at any one time.

The UMB program is expected to include preparation of a standard Seismic Retrofit Inconvenience Plan agreement through the Residential Rent Stabilization and Arbitration Board (Rent Board) to address issues important to both tenants and landlords, including temporary relocations. Such a Plan would also include issues of habitability such as dust, noise, loss of privacy, and other impacts and inconveniences of construction.

Guidance for building owners concerning construction, dislocation, and other retrofit issues should be incorporated into a Building Owners Handbook, to be prepared under the UMB program and made available to all UMB owners.

3. Specific Mitigations for Program-Induced Development Impacts

Essentially because of their increasing costs, Alternatives C, D, and E would involve, in order, increasing levels of impacts which would be induced by a mandatory strengthening UMB program. The alternatives would reduce displacement and building loss effects in the event of an earthquake. Similarly, a mandatory strengthening program would ultimately save more architectural and historically significant UMBs in the event of damaging earthquakes than would be lost to program-induced demolition. However, program-induced losses of historic buildings would nonetheless be expected, particularly under Alternative E.

Such impacts would result from likely building outcomes given the financial burden of mandatory retrofit. Reduction of these impacts could be

achieved only through some means of financial assistance for retrofit of the buildings at risk of demolition. At the present time, available assistance is small in relation to the total costs, and it can only be assumed that substantial funding in the future would not be available. Should such funding become available, and should it be targetable toward those buildings with housing, commercial space, or architectural resources most in need of assistance, program-induced impacts would be proportionately reduced.

In the absence of financial assistance, consideration could be given to providing exemptions, appeals, and/or the ability to retrofit to lesser standards buildings of particular merit which lack the financial capability to carry out retrofit work. Such mitigations would, however, provide lesser seismic life safety and could increase the risk of eventual building loss anyway in the event of an earthquake. To reduce these risks, it could in some cases be feasible to require reduced occupancy loads or times of occupancy for certain buildings. For example, rather than force an historic church to demolish due to lack of resources to retrofit, a requirement of limiting occupancy to just a few hours per week might be imposed. Such flexibility could provide some measure of improved safety while avoiding some of the most severe potential program-induced building losses.

D. HIGHLIGHTS OF ENVIRONMENTAL GAINS AND LOSSES

Table I-6 presents, in briefest summary form, highlights of important gains and losses estimated for each alternative. The Table is intended as a guide for the public and decision-makers in evaluating the alternatives. The information in the Table is not necessily self-explanatory, contains numerous limitations, and is subject to a wide margin of error (although the relationships among alternatives are believed to remain valid). Therefore, the Table should be used only in conjunction with a careful reading of the text of this EIR.

TABLE I-6
SUMMARY OF UMB PROGRAM ALTERNATIVES
HIGHLIGHTS OF IMPORTANT LOSSES AND GAINS

CAUTION: All figures can be fully understood only after reading EIR text!
All figures apply only to 2007 S.F. unreinforced masonry buildings

	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Residents Temporarily Displaced for Retrofit Construction	n/a	*	few	5,000	13,000
Businesses Temporarily Displaced for Retrofit Construction	n/a	*	few	1,000	1,700
Employees Temporarily Displaced for Retrofit Construction	n/a	*	few	5,100	8,900
Dwelling Units lost to Demolitions or Conversions	300	*	500	2,900	11,500
Businesses Permanently Displaced due to Demolitions or Conversions	230	*	350	520	1,130
Historic Buildings Demolished	20	*	35	75	175
Expected **Annual** Earthquake Losses of Dwelling Units	165	*	50	24	15
Expected Loss of Dwelling Units in 7.0 Hayward Fault Earthquake	3,170	*	480	155	50
Expected **Annual** Businesses Displaced due to Earthquakes	64	*	20	8	5
Expected Businesses Displaced in 7.0 Hayward Fault Earthquake	1,450	*	330	70	30
Expected **Annual** UMB Deaths and Major Injuries due to Earthquakes	63	*	30	9	5
Expected UMB Deaths and Major Injuries in 7.0 Hayward Fault Earthquake at 3:00 p.m.	2,190	*	1,020	220	115
Expected **Annual** Number of Historic Buildings Demolished due to Earthquakes	10	*	3	1	1
Expected Number of Historic Buildings Demolished due to 7.0 Hayward Fault Earthquake	240	*	50	10	4

* Not quantifiable but expected to be close to numbers given for Alternative A.

E. PUBLIC REVIEW AND DECISION PROCESS

The UMB Program development process will continue with the development of draft recommendations on a variety of program elements and mitigation measures by the CAO's UMB Task Force, with input from the UMB Community Advisory Committee and other interested parties. The City Planning Commission's public hearing on the completeness and adequacy of this Draft EIR is scheduled for December, 1990, with certification tentatively planned for March 1991, prior to action by the Board of Supervisors.

The UMB Task Force is expected to develop a package of final policy recommendations to be submitted to the Board of Supervisors by the end of 1990. Prior to decision-making, the Board of Supervisors will conduct public hearings. Depending on the nature of the Board's decisions, an ordinance (or amendments to existing ordinances) would be drafted, probably leading to further public hearings before final action.

The decision making process will be aided by information contained in the UMB Program impact studies. The socio-economic impact study /1/ is available from the Department of City Planning, 450 McAllister Street, 4th Floor Reception.

NOTES - SUMMARY

1. Recht Hausrath & Associates, "Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings: Socioeconomic and Land Use Implications of Alternative Requirements," 1990. For San Francisco Department of City Planning.

2. The Working Group on California Earthquake Probabilities, "Probabilities of Large Earthquakes Occurring in California on the San Andreas Fault," Menlo Park, CA: 1988. United States Geological Survey Open File Report 88-398, press release of July 19, 1990, and newspaper insert--"The Next Big Earthquake in the Bay Area May Come Sooner Than You Think", September 9, 1990.

3. Rutherford & Chekene, "Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings," 1990. For San Francisco Department of City Planning.

II. PROJECT DESCRIPTION

A. INTRODUCTION

The City of San Francisco is considering several alternative approaches to address the earthquake-related hazards associated with approximately 2000 privately owned older buildings that were constructed with load-bearing walls made with either bricks, adobe, or stones and mortar. These walls are not sufficiently reinforced with steel and were not usually designed to withstand lateral forces of earthquakes (side-to-side shaking). Consequently, these buildings will be more likely than other building types to sustain earthquake-related structural damage that is life-threatening.

In addition to unreinforced masonry buildings (UMBs), there are other types of existing buildings that have demonstrated vulnerabilities to earthquake-generated seismic forces. For instance, there is statewide concern for performance of non-ductile concrete frame buildings and certain liftslab and tilt-up construction buildings. San Francisco's focus to date has been on UMBs because they are numerous, because they are primarily located in densely populated areas and because they are generally known to be more vulnerable than other building types to life-threatening damage in earthquakes.

The City is aware of the cost and potential displacement burdens that could result from a mandate to structurally strengthen UMBs. The City's objective has not only been to decide whether or not and to what extent to require owners to strengthen these UMBs, but also to develop program support to lessen adverse effects that may result. This EIR and a companion report, <u>Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings</u>: <u>Socioeconomic and Land Use Implications of Alternative Requirements</u> (RHA 1990), are intended to enable the public and the Board of Supervisors to discuss the relative merits of each or of some combination of approaches that reflects the public interest in balancing the risks, costs and benefits of earthquake hazard reduction in UMBs. Five alternatives have been

identified for assessment in this EIR. Three (and possibly four) of the alternatives would involve amending the San Francisco Building Code (SFBC).

Much of the technical information in this EIR is summarized from or taken directly from a report prepared under contract to the Department of City Planning by Rutherford & Chekene, a San Francisco-based firm of consulting engineers. The report, Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings (R & C 1990) and the RHA report are available for review, by appointment, at the Department of City Planning, 450 McAllister Street, 6th floor (558-6396). The R & C report describes the methods and assumptions used in specifying the three mandatory strengthening level alternatives and their associated costs and casualty and damage consequences. The EIR also freely draws on UMB and earthquake information available from public agencies, especially the United States Geological Survey, the Bay Area Regional Earthquake Preparedness Project and the California Seismic Safety Commission. To a large degree the overall approach to the studies on which the EIR is based is reflective of a previous study completed under contract to the Department of City Planning, Earthquake Hazards and Housing, The Center for Environmental Change, Inc., 1987, Mary C. Comerio, Principal Investigator (copies available from Department of City Planning, 4th floor Reception).

B. BACKGROUND TO ALTERNATIVES IDENTIFICATION

San Francisco's active initiatives to reduce the City's earthquake hazard are described in detail in Section III of the City's "Hazard Mitigation Plan Following the Loma Prieta Earthquake of October 17, 1989," prepared by the Chief Administrative Officer. Since 1947 the City of San Francisco has adopted a series of policies and ordinances specifically intended to reduce the vulnerability of people and property in the face of the known earthquake hazard. These measures have ranged from San Francisco Building Code amendments protective of life safety in new buildings, to the use of both general fund and voter-approved bond monies to strengthen selected public buildings (primarily police and fire stations) to increase their ability to

operate effectively during the immediate period following a damaging earthquake.

Currently, the level of the earthquake hazard and ways to reduce it are being studied and considered. Revision of the Community Safety Element of the City's Master Plan has recently begun and is scheduled for completion in 1992. During this process the City will undertake a public review in which the City's level of earthquake risk will be reassessed. A wide range of measures to further reduce the level of hazard will be considered. These could include new requirements for retrofitting existing structures such as bolting small residential structures to their foundations and strengthening other dangerous buildings such as those mentioned above (non-ductile concrete, liftslab or tilt-up buildings). More rigorous requirements for new construction in areas where low strength or unstable soils are located may also be considered. Other types of earthquake hazard reduction activities that could be considered in this process include organizational, training or equipment changes for improving the City's capacity for emergency response. This may entail improvements in fire suppression capabilities, the training of neighborhood volunteers for post-earthquake search and rescue or fire suppression, or re-evaluating the potential effectiveness of the public warning system for the thousands of residents subject to flooding if any of the four dams that pose risks fail during an earthquake.

In the meantime the City has already instituted certain requirements to reduce some of the hazards. Existing buildings must meet the provisions of the building code under which they were built unless the building has been remodeled, altered or repaired in such a way as to enable a change in the building's use, a change in capacity (occupancy) or a change in the structural loading. In these cases, or if a building is substantially remodelled as defined in Section 104(f) and Section 2313 of the most current edition of the SFBC, the building must be structurally strengthened (retrofit) to meet lateral force resistance requirements of the 1973 Uniform Building Code (UBC) for new buildings.

Another public safety improvement applicable to existing buildings is codified in Chapter 2, Section 251 of the SFBC. This section spells out requirements for correcting life safety hazards posed by existing parapets and roofline appendages on all building construction types. Parapets (portions of walls extending above roof level), cornices (continuous horizontal projections from a wall, usually near the roof level) and other ornamentation that are not securely anchored to the building pose a high life safety threat during earthquakes because they readily shake loose, often to fall through roofs of adjacent buildings or on street level passersby. Non-structural items that are inspected for needed corrections under this program may include balconies, chimneys, cornices, overhangs, parapets, railings, roof-mounted equipment, statuary, stacks, tanks, and roofline wall decorations. Compliance with the parapet ordinance is virtually complete in the areas of Downtown, Chinatown, the Tenderloin, and the Bush-Sutter and Van Ness Avenue corridors. Inspections and compliance notices are now active in the South of Market area to be followed by activities in outlying areas of the City. The parapet safety program requirements are expected to be completed throughout the City by 1997 at the latest.

The subject of this EIR--unreinforced masonry buildings hazard reduction--was initiated approximately nine years ago when the Seismic Investigation and Hazard Survey Advisory Committee (SIHSAC) was charged by the San Francisco Board of Supervisors to make recommendations for improving the seismic performance of existing unreinforced masonry buildings. In partial fulfillment of this charge, SIHSAC recommended to the Board (in 1981) that San Francisco abate the hazard posed by these older UMBs by adopting an ordinance patterned after the Applied Technology Council's 1978 "Tentative Provisions for the Development of Seismic Regulations for Buildings" as illustrated by the Los Angeles City Earthquake Safety Ordinance of 1981./1/ As an essential first step toward drafting such an ordinance for San Francisco, it was further recommended that an accurate census of older UMBs be performed. This census was taken by the Bureau of Building Inspection (BBI) of the San Francisco Department of Public Works during 1985, 1986, and 1987. In early 1987, owners were informed that their building was identified in this census.

Before and during the period that BBI was performing the UMB survey, the State of California was considering ways to encourage local jurisdictions to address the hazard that these buildings represent to the health and safety of the public. In 1986, the California Legislature passed and the governor signed SB 547, (the Unreinforced Masonry (URM) Law) which required local building departments to identify UMBs and provide this information to the local legislative body and to the California Seismic Safety Commission by January 1990. Accordingly, the BBI census was submitted in December 1989.

The starting point for the UMB survey was the City's collection of Sanborn maps. These maps are compiled by a private source primarily as a service to fire insurance companies. They show the configuration and construction type of all buildings for each block of the City . The Sanborn maps were used as the basic source of information on construction type. This source was supplemented by exterior inspections by BBI staff and follow-up field checks in response to owner-provided information including reported demolitions and reported structural strengthening of the building. It must be recognized that the BBI list of UMBs is a working list, subject to change as new, confirmable information becomes available. The BBI list undoubtedly contains some errors in designation of unreinforced masonry bearing wall buildings and other information. (Such problems can be discussed with BBI Staff, 558-6168). However, it is believed that the amount of error is small. For purposes of EIR assessment 2007 UMBs were included for analysis. Any program adopted by the City would likely affect a greater or smaller number of buildings, and a few different buildings from the 2007 studied. (For instance, to date, 15 of the UMBs have been demolished due to damage sustained in the October 1989 Loma Prieta earthquake; these have not been removed from the UMB studies' list of 2007. And, prior to enactment and implementation of any program, a few more UMBs will have been strengthened or demolished.) However, the general information, analysis, and conclusions should not be substantively different on a program level.

In response to publication of the list and summary report of building characteristics, several issues were raised that warranted further study prior

to definition of hazard reduction alternatives. Of particular concern was the knowledge that the UMBs contain approximately 21,800 dwelling units that comprise a substantial portion of the low-rent and single-room occupancy (SRO) units in San Francisco, and are populated by a considerably higher proportion of low-income and elderly tenants than the City as a whole. In addition, the UMBs contain about 5400 tourist units, some of which are likely used as dwellings by city residents. In part this concern was raised because of the existing housing shortage in San Francisco which cuts across all housing types but is particularly acute for low-cost housing. The concern was amplified because in implementing the City of Los Angeles' UMB hazard reduction program, 5600 housing units have been demolished within the first eight years - mostly low-cost rental units in residential hotels or old multi-unit apartment buildings.

Because of this concern, the Department of City Planning contracted for a study of cost and rent implications for multi-unit residential buildings. The study concluded that housing resources could be threatened if the City imposed a building code requirement to strengthen the UMBs and that if there is a requirement the City should also consider a program to include demolition constraints, rent control provisions, temporary housing alternatives for dislocated tenants and a financial program to assist owners and residential tenants with the costs. Provision of a centralized team management of the program to enable a coordinated approach across involved City agencies was also recommended./2/

In 1987 the City's Chief Administrative Officer convened a UMB Task Force and a Community Advisory Committee (CAC) to develop program recommendations to the Board of Supervisors. The UMB Task Force is contemplating program objectives that will balance the relevant concerns of life safety, housing conservation, historic resources, business opportunities and costs. The City's Environmental Review Officer, with the concurrence of the City Attorney, determined that the program must be subjected to compliance with the California Environmental Quality Act and that an EIR would be required to accomplish this.

The UMB Task Force also requested more study of economic and social issues so that program development could more comprehensively consider how to alleviate adverse effects of a UMB retrofit requirement. This social and economic information is being presented in the separate document, Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings: Socioeconomic and Land Use Implications of Alternative Requirements.

In consultation with the CAC, the UMB Task Force also set forth five general alternatives that the EIR and social and economic studies should consider. These alternatives provide a range in the level of strengthening, from requiring (at minimum) no program, to requiring (at maximum) retrofitting to the level of the current SFBC, Section 104(f), previously discussed.

C. CAUSES OF DAMAGE IN UMBs

UMBs have repeatedly presented a life-safety threat to both their occupants and passersby on the street during strong earthquakes. Although not the only type of hazardous building, or hazardous structure, UMBs figure prominently in scenes of destruction following earthquakes. As a group they suffer more damage for a given level of ground shaking than any other type of building, though not every UMB is hazardous. Examples exist of good performance of some UMBs in strong earthquakes due to one or more of several reasons: quality workmanship during their construction; adequate wall anchors and small openings; or perhaps the capricious nature of shaking during the particular earthquake. Nor are UMBs automatically a collapse hazard. Even after external walls fail, internal wood partitions, although not designed for that purpose, may be adequate to temporarily support the floors and roof. This differential UMB performance based on the quality of materials and construction was documented early in earthquake investigations. In reporting on the effects of the 1906 San Francisco earthquake, a United States Geological Survey (USGS) panel related that the "Experience shows that buildings constructed with exterior brick walls laid in common mortar, with timber columns and girders, ties and braced little or not at all, constitute a third class of buildings which are nonresistant to a severe earthquake,

particularly if they are erected upon a poor foundation. Even if the girders and columns are of metal, they are pulled apart, and the walls fall inward or outward during the shock. Only rich Portland cement, laid with wetted brick, and strong joists, ties, and anchorage, endured the stress"./3/

Systemic weaknesses leading to earthquake-related damages in UMBs have been investigated by engineers in the immediate post-quake period in order to document how ground shaking and other seismic forces affect various buildings' structural elements in different kinds of earthquakes. A review of available literature indicates there is little uncertainty about the common failure mechanisms of UMBs as a class of building construction./4/ The typical UMB deficiencies that make them vulnerable to seismic forces are categorized and summarized below. They are described in more detail with more technical language in Appendix A. A Glossary of technical terms is provided at the very back of the EIR. These common modes are illustrated in Figure II-1.

Specific ways in which UMBs typically fail in earthquakes include:

1. Parapet failure
2. Non-parapet falling hazards
3. Wall-diaphragm tie failure
4. Wall Failure in bending between diaphragms
5. Excessive diaphragm deflection
6. Corner Damage
7. In-plane wall failure
8. Roof and/or floor collapse
9. Soft story or other configuration-induced failure

Methods to strengthen (or retrofit) existing UMBs are designed to correct some or all of these typical failure modes, as described in the particular alternative approaches that are currently being considered by the City and County of San Francisco.

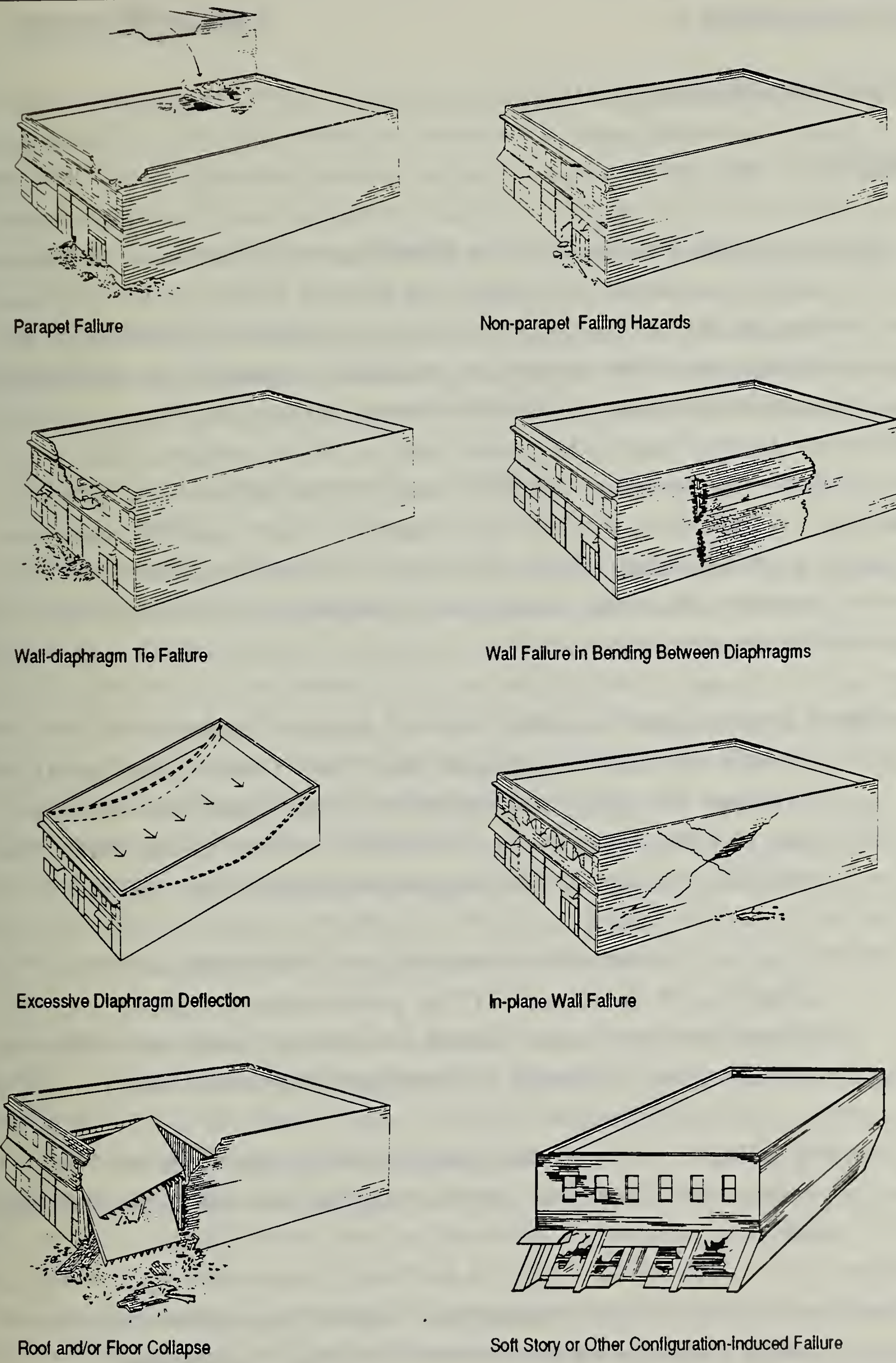


Figure II - 1 Diagrams of Typical Damage to UMBs From Earthquakes

D. ALTERNATIVES ANALYZED IN THIS EIR

1. INTRODUCTION

For impact assessment purposes, five general alternatives were studied that will ultimately be shaped, developed and refined by the decision process, based on findings of the EIR and other studies, and public discussion of the numerous issues involved. Two or more of these may ultimately be combined in a program and applied differently to different building uses. The alternatives can be very generally categorized as (1) no project, (2) voluntary program, (3) mandatory retrofit to a relatively low level of strengthening, (4) mandatory retrofit to a moderate level, and (5) mandatory retrofit to a relatively high level. There will also be consideration of several other elements which may or may not ultimately be included in a program or ordinance, such as:

- time frame for compliance for the full program. Compliance schedule for the full program (the time it would take for all buildings to comply with a mandatory requirement) could range from five to thirty years. Particular attention has been given to 5, 10, 15, and 30-year programs throughout the analysis.

- prioritization for serially scheduling which buildings or categories of buildings will be given notice to comply. It is assumed that once given notice, the noticed owner would have one to three years to comply with the mandatory requirement.

- possible criteria, if any, that describe which buildings or categories of buildings can be exempted from complying with the code.

In addition, the City will be considering the feasibility and desirability of measures to alleviate various potential adverse effects of a program, including but not limited to providing incentives to encourage strengthening

(or other methods to achieve program objectives) and assembling resources to reduce potential for disruption or financial burdens placed on owners, commercial and residential tenants and other users of the UMBs. For purposes of impact assessment and supportive analysis, no publically provided financial resources were assumed to be available as they are in very limited supply.

An understanding of ordinance provisions from other California jurisdictions is important as background to consideration of alternatives for San Francisco. These programs are briefly described in the following section.

2. ORDINANCE PROVISIONS IN OTHER JURISDICTIONS

Various local jurisdictions in California have passed and are implementing ordinances that seek to reduce life-safety hazards posed by UMBs in earthquakes. Because of early adoption and the large number of buildings involved, the efforts of three cities are particularly important: Long Beach, Santa Rosa and Los Angeles. The history and provisions of these programs are summarized in Blair Tyler and Gregory/5/ and described in detail for Long Beach and Los Angeles by Alesch and Petak (available for review at the Department of City Planning, 450 McAllister Street, 6th floor (558-6396)./6/ They are briefly described below. Appendix B of the EIR contains a summary history of the Los Angeles ordinance, including a description of its problems and the progress Los Angeles has made in solving them.

In 1959, Long Beach enacted the first local program to reduce UMB hazards. At that time, the approximately 1000 UMBs were treated as a public nuisance and the city slowly began to issue condemnation orders. After much local controversy, property owners mounted a campaign to overturn the ordinance or get financial assistance from the city. Enforcement stalled. Then, in 1971, stimulated by the San Fernando earthquake, Long Beach revised the program. The UMBs were classified as high, medium or low risk depending on the occupancy and location of a building in addition to its structural characteristics. The revised ordinance proved cumbersome to administer and enforcement was very slow. The ordinance was amended again in 1976 to clarify

distinctions among the risk categories and set 1991 as the specific time limit for compliance and smoother progress toward meeting this deadline is now being made.

The City of Santa Rosa experienced damaging earthquakes (Richter magnitude 5.6 and 5.7) on October 1, 1969 that caused more than $5 million (in 1969 dollars) in damage--mostly to UMBs--in downtown Santa Rosa. The city responded with a combination of downtown redevelopment and a program to abate existing structural hazards throughout the city. The city established procedures to inspect all potentially hazardous buildings built before 1958 (not just UMBs), with priority given to high occupancy buildings, critical facilities and government buildings. Buildings failing to comply with the 1955 UBC are reviewed and plans for compliance are prepared by an engineer specializing in structural work. A building owner has one year after notification to bring the building into compliance with the 1955 code or demolish it.

In 1981, the City of Los Angeles launched a program to require the strengthening or removal of all its 8000 UMBs within about 20 years. After the 1985 Mexico City earthquake, the City Council directed staff to accelerate the program and set 1992 as a target date for completion. By October 1989, about 3000 buildings had been brought into compliance with the standard established in the Los Angeles ordinance and another 1000 had been demolished /5/.

By 1986 seven other local jurisdictions (Gardena, Huntington Beach, Morgan Hill, Palo Alto, Santa Ana, Santa Monica and Sebastopol) had also adopted ordinances to reduce the earthquake-related hazards of existing buildings with primary emphasis on UMBs. By this time, San Francisco had completed the process of identifying its population of UMBs.

In 1986, the State of California adopted the Unreinforced Masonry Building Law (Government Code Chapter 12.2), often referred to as SB 547. The law is estimated to affect 25,000 UMBs throughout the state. Briefly, the law

requires cities and counties within California's Seismic Hazard Zone 4 to do two things: first, inventory all UMBs in their jurisdictions and second, establish local programs to mitigate the earthquake hazards in those buildings by January 1990. According to the California Seismic Safety Commission, these local programs must include notification of the owners regarding the potential earthquake hazards of their buildings. The program should include steps to mitigate the hazards but the law does not require local jurisdictions to mandate that they be strengthened or demolished. The law suggests that local jurisdictions proceed to adopt a program by ordinance to reduce the hazards of unreinforced masonry buildings by setting standards for the structural strengthening of these buildings or specifying measures to reduce the number of occupants in these buildings.

Based on its 1990 annual report to the legislature, the California Seismic Safety Commission reports that 58% of the affected jurisdictions were substantially in compliance with the law. Only 5% have not yet started their UMB inventory/7/.

3. ALTERNATIVES SELECTED FOR IMPACT ASSESSMENT

During the summer of 1989 the UMB Task Force finalized its recommendations for alternative approaches to a retrofit program to be analyzed in this EIR. These were forwarded to the Department of City Planning in August 1989 by the Office of the Chief Administrative Officer (CAO Memo of August 21, 1989). Prior to arriving at these recommendations, the Task Force had considered the limited number of existing approaches. The approach that had been most utilized was that of the City of Los Angeles (often called Division 88), based on Chapter 23 of the Uniform Building Code (UBC), 1985 edition. By 1987, this approach was being recommended by the California Seismic Safety Commission (SSC) as a model ordinance./9/ This approach was known to be less costly and less disruptive to occupants during construction than that of the San Francisco Building Code based on the 1973 UBC requirements for new construction.

In its choice of strengthening requirements, the Task Force selected general alternatives based on the SSC model ordinance and the existing, higher strengthening requirement of the SFBC. For analysis purposes, the alternative strengthening level based on the SSC's model ordinance (Alternative D) was further refined to reflect up-to-date engineering approaches and practice. The refinements were specified by the City's consultant, Rutherford & Chekene, in consultation with the San Francisco Department of City Planning and the UMB Task Force.

Five basic alternatives addressing the program objective of reducing earthquake-generated UMB hazards to life safety are being analyzed, of which three involve mandatory retrofit of UMBs to different levels of strengthening. Alternative A is "no project" (no program beyond those already in effect). Alternative B is a "voluntary retrofit" program based on the City of Palo Alto's approach that may require, for example, a retrofit engineering study and cost estimate for each UMB to be performed and made public. Alternative C--based partially on, but more stringent than, Phase I of the SSC's model ordinance--would require "anchoring walls to floors and roof" plus measures to reduce the potential for out-of-plane wall failure. Alternative D is a mandatory program requiring strengthening in a manner representative of current practice in implementing the Los Angeles Building Code, as reflected in current (September 1990) proposals to amend the Uniform Code for Building Conservation. Alternative E is the mandatory application of Section 104(f) of the San Francisco Building Code, seismic strengthening that is currently triggered in any building only upon substantial addition, alteration, or intensification of use.

In general, Alternatives C, D, and E, respectively, involve increasing amounts of mandated strengthening activities for buildings. The UMB Task Force has selected these three strengthening levels as representative of a reasonable range of feasible alternatives that would all serve the program objective of reducing the earthquake-related, life-safety hazard posed by UMBs. The specific number and type of needed strengthening activities would vary widely on a building-by-building basis. The most appropriate retrofit

solution for any one building will depend on its structural characteristics, general conditions, and the relative importance placed on several other variables such as initial construction cost, occupancy status and use of the building during strengthening construction, long term effects of strengthening elements on building function, aesthetics, and other non-seismic improvements that may be made at the same time. The most appropriate retrofit program would be one which optimizes the objectives of increased life safety and minimizing adverse impacts. Such a program may well consist of a blend of the affirmatives selected for analysis.

These basic alternatives are considered using different timelines for full program compliance. Completion of the upgrade of all UMBs could occur in a five to thirty-year period with the upgrade of individual buildings expected within one to three years of receipt of an order to comply. Priority for serially ordering upgrade has also yet to be determined. In some local jurisdictions this order is based on a hazard index. Such an index may be based upon a combination of the following: allowable occupancy level; public need for building use right after an earthquake; size or height of building; pedestrian traffic level; or quality of underlying soil conditions. Exemptions may also be considered. Exemptions to be considered in developing an ordinance could include buildings with, for example, low allowable occupant load, low average weekly occupancy load, residential buildings with less than five or other number of units, and storage warehouses.

a. Alternative A: No Project.

Under this alternative, no new program to reduce seismic hazards of UMBs would be adopted. Existing general programs to increase life safety and upgrade emergency response would continue at their present level and pace. These efforts include: enforcement of the Citywide building parapet hazard abatement program; the Earthquake Safety Program (an effort to reduce earthquake vulnerability in City-owned buildings, especially police and fire stations); the existing San Francisco Building Code requirement (Section 104(f)) that buildings be structurally strengthened if a major remodel is

undertaken; a change in intensification use or occupancy is proposed; and emergency preparedness efforts by the Mayor's Office of Emergency Services, the Fire Department and other departments. In addition, the Bureau of Building Inspection would maintain for public inspection its working list of the identified UMBs.

b. Alternative B: Voluntary Program.

Conceptually, this program would provide resources to develop a program to encourage voluntary upgrade or demolition, including an informational program and an owner duty to inform building occupants and prospective buyers of the building's condition. Precise components of such a program have not been identified. As part of such a program, an owner may possibly be required to submit an engineer's strengthening plan to include a cost estimate so that a prospective buyer would be more fully informed of the building's condition. If strengthening were undertaken, it would be required at the level provided for in SFBC, Section 104(f) (Alternative E in this EIR).

c. Alternative C: Anchorage and Interconnection.

This alternative would require an owner to anchor and interconnect all parts of the UMB, based on an engineering evaluation report prepared for the building. The plans would be designed so that anchorage of masonry walls to each wall, each floor and roof would resist a minimum specified seismic force level. Strengthening activities that would reduce the likelihood of collapsing walls would also be required. Typically such work is confined to the perimeter walls, although larger buildings may contain interior unreinforced masonry walls that could also require strengthening.

Of the eight causes of damage in UMBs listed in Section II.C., (other than parapet failure, which is being addressed under the existing Parapet Ordinance), Alternative C would address well non-parapet falling hazards, wall-diaphragm failure, and wall failure in bending between diaphragms. It is designed to address corner damage but its effectivess is in some doubt by

engineers. It also would reduce the probability of roof or floor collapse. The Alternative would not address the other failure modes (excessive diaphragm deflection, in-plane wall failure, soft-story or other configuration-induced failure).

The essence of this alternative is bolting (with tension anchors) walls to horizontal surfaces (the floors and roof), which alone has been considered an alternative by itself (as discussed later under "Alternatives Considered and Rejected"). However, vertical bolting (shear anchoring) is also included within Alternative C and, for some buildings, installing bracing from a floor to the structural level above, or adding wall braces at a ceiling level to reduce the effective wall height, would also be required. These strengthening activities were added to "tension anchors only" to form this alternative for two main reasons. First, once the floor-wall interface is open and available for installation of tension anchors, the addition of shear anchors would be relatively inexpensive. This work can decrease damage, particularly near the corners of UMBs, and it also would alleviate the need to reopen this joint should a more complete retrofit be undertaken later. Second, addition of these strengthening elements to reduce the potential for out-of-plane wall failures is included based on limited evidence from the 1988 Whittier Narrows earthquake. Damage patterns in that earthquake indicated there may be an increased tendency for out-of-plane failure to occur after "anchors-only" had been installed. Since the out-of-plane failure mode can be quite damaging, requirements to guard against it are included in this alternative.

d. Alternative D: Proposed Uniform Code for Building Conservation (UCBC).

Alternative D was selected primarily because it represents the recent engineering thinking that incorporates the Los Angeles UMB retrofit experience over the past decade. This alternative stems from the Los Angeles "RGA" method and is taken from a version of a proposed amendment to the Uniform Code for Building Conservation (UCBC). A related amendment was adopted by the International Conference of Building Officials (ICBO) in September 1990. The final version (developed by a joint committee of SEOC and CALBO) is now

(September 1990) being examined in detail to determine whether or not all of or portions of what was adopted will be recommended to local jurisdictions by the California Seismic Safety Commission. The UCBC's "general procedure" references the UBC's provisions for new buildings and provides allowable material stresses and other factors for a traditional analysis--an approach akin to SFBC, Section 104(f). The code also provides for a second approach to analysis, design and strengthening--the "special procedure"--that allows certain UMBs to be analyzed according to another method that is currently in common use to comply with the Los Angeles UMB ordinance. (See Note 10)

This alternative would require that all UMBs be evaluated, designed and retrofitted according to the engineering approach of the "special procedure" of proposed amendments to the UCBC (as identified in January 1990). In alternative D, this "special procedure" is assumed to be applied to all of the UMBs, without limitations in its use. With this alternative, the installation of wall anchors and applicable out-of-plane anchorage required by Alternative C would, in most cases, be supplemented by strengthening of the building elements including diaphragms and in-plane shear load transfer elements.

The analysis procedures for Alternative D are based on a different methodology and conceptual framework than Alternatives C or E. The difference allows for the use of existing plaster walls as crosswalls to reduce the need for diaphragm strengthening. Crosswalls are considered to absorb energy and thus act as dampers for earthquake shaking forces. Not all buildings under Alternative D would require strengthening of the roof diaphragms. Most floor diaphragms would not require additional strengthening. Additional shear walls can sometimes be installed, to reduce the lateral force demand on diaphragms.

Alternative D would address all of the failure modes of UMBs described in Section II.C.; its effectiveness would generally fall between that of Alternatives C and E for excessive diaphragm deflection, in-plane wall failure, roof or floor collapse (much better than Alternative C), and soft story or other configuration-induced failure.

In-plane strengthening of exterior URM walls may be needed for walls in multi-story buildings, especially those with window or door openings. All building faces with storefronts that have little or no solid wall would require some kind of in-plane strengthening element at or near the storefront wall. This may be accomplished by a rigid or braced steel frame or by a masonry shear wall (this will depend on the stress, number of stories and similar factors). The need for in-plane elements in a retrofit project represents a substantial increase in construction activity when compared to Alternative C. Construction activities are somewhat beyond a "remodel", wherein there may be extensive removal of finishes, installation of shear walls, new finishes and possibly installation of structural steel. In some cases, new masonry or concrete walls, or gunite over existing walls would be needed. Some foundation work may be needed for some buildings.

e. Alternative E: SFBC, Section 104(f).

This alternative would require that UMBs be retrofit to a level in accordance with Section 104(f) of the SFBC (currently required only for any type of pre-1973 building that is proposed by an owner for expansion or intensification of use). Section 104(f) essentially requires reinforcing existing buildings to the seismic force resistance levels that were required by the 1973 UBC for new buildings. (While records to document application of Section 104(f) are not kept, knowledgeable sources in the BBI estimate that no more than 2 to 3 UMBs annually have been strengthened to this level since the requirement's inception in 1973). Alternative E would address all of the UMB failure modes discussed in Section II.C. most effectively of all the three alternatives.

In addition to the requirements of Alternative C, Alternative E would require strengthening of all roof diaphragms. Most floor diaphragms would also require strengthening, although lower floors of multistory buildings, floors in buildings with a very small footprint area, and floors with certain configurations of existing sheathing (multiple layers of sheathing, diagonal sheathing) may be adequate. In buildings with square or rectangular plan

shape, it may be possible to strengthen only a one-room-wide strip of floor at the perimeter of the building, although if plywood is used, this could create a small step in floor elevation. Diaphragm strengthening can be minimized by adding freestanding in-plane strengthening elements near the middle of the building.

In-plane strengthening of exterior URM walls would be required for most buildings with walls over one story in height that have window or door openings, and even for most solid property-line walls over four stories tall. All building faces with storefronts that have little or no solid wall will require some kind of in-plane strengthening element at or near the storefront wall. The need for in-plane elements in a retrofit project represents a notable escalation in construction activity. Not only are construction activities far beyond a "remodel", utilizing structural steel or concrete, but new foundations are required. Foundation work is highly variable depending on the soil conditions and height of the building, but would normally be greater and apply to more buildings than under Alternative D.

4. ALTERNATIVES CONSIDERED AND REJECTED

In addition to the five alternatives being assessed, two additional levels of retrofit strengthening were considered and rejected by the City's UMB Task Force. One alternative was a strengthening level often referred to as "bolts only". It would entail the mandatory installation of tension anchors to connect masonry walls to other walls and to the building's diaphragms (floors and roof). This work would be required for most UMBs in all three strengthening levels selected for assessment, but the use of "anchor bolts only" is thought to be insufficient by itself by almost all structural engineers for the reasons expressed in the following quotations:

"While the benefits of wall, floor and roof ties for unreinforced masonry buildings are undeniable, their value as the sole strengthening measure is not established. Moreover, engineers are very reluctant to suggest that such limited measures would comprise an effective mitigation program."/11/

"(T)he engineers were uncomfortable with recommending only the first stage of the Los Angeles code (tension anchors only) because of the variation in building size and type....There are two reasons for hesitation when recommending safety minimums. First, minimum standards often get translated into maximum requirements and this could leave people with a false sense of security about the seismic safety of their building. Second, seismic upgrading of existing buildings is a relatively new field and our knowledge is limited."/2/ While "anchor bolts only" can do much to gain seismic safety in certain buildings, as a prescriptive approach it could leave completely unaddressed the primary failure modes of other types of UMBs. Therefore, Alternative C, consisting of "anchor bolts" plus out-of-plane wall bracing, was chosen as the minimum level of strengthening for analysis.

The second alternative considered by the UMB Task Force was a strengthening level higher than SFBC, Section 104(f). This idea was dismissed from further consideration by the UMB Task Force primarily because of its belief that the current requirement is sufficiently protective of the public health and safety to render unnecessary and undesirable a higher requirement with higher costs and levels of disruption and displacement. Furthermore, no known professional association of engineering or building officials has recommended or sanctioned provisions for retrofitting UMBs at strengthening levels higher than San Francisco's Building Code, Section 104(f).

E. PUBLIC REVIEW AND DECISION PROCESS

The UMB Program development process will continue with the development of draft recommendations on a variety of program elements and mitigation measures by the CAO's UMB Task Force, with input from the UMB Community Advisory Committee and other interested parties. The City Planning Commission's public hearing on the completeness and adequacy of this Draft EIR is scheduled for December, 1990, with certification tentatively planned for March 1991, prior to action by the Board of Supervisors.

The UMB Task Force is expected to develop a package of final policy recommendations to be submitted to the Board of Supervisors by the end of 1990. Prior to decision-making, the Board of Supervisors will conduct public hearings. Depending on the nature of the Board's decisions, an ordinance (or amendments to existing ordinances) would be drafted, probably leading to further public hearings before final action.

Other City decision-making bodies could be involved with various aspects of a UMB program depending upon which of the various City Codes would need to be amended to implement the program. Possible amendments of the Building Code, City Planning Code, Administrative Code, and the Rent Stabilization Ordinance have been identified by the City Attorney, which would involve the Bureau of Building Inspection, City Planning Commission, Board of Supervisors, and Rent Stabilization Board. In general, such detailed Code amendments would follow the Board of Supervisors' decision on an overall program.

The decision making process will be aided by information contained in the UMB Program impact studies. The socio-economic impact study /12/ is available from the Department of City Planning, 450 McAllister Street, 4th Floor Reception.

NOTES - PROJECT DESCRIPTION

1. Seismic Investigation and Hazard Survey Advisory Committee (SIHSAC) and San Francisco Department of Public Works, Bureau of Building Inspection, "A Survey of Unreinforced Masonry Buildings in San Francisco," 1987.

2. Comerio, Mary C., "Earthquake Hazards and Housing," Berkeley: The Center for Environmental Change, 1987. Prepared for the San Francisco Department of City Planning.

3. United States Geological Survey (USGS), The San Francisco Earthquake and Fire of April 18, 1906 and Their Effects on Structures and Structural Materials. Washington: Government Printing Office, 1907.

4. Rutherford & Chekene, "Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings," 1990. For the San Francisco Department of City Planning.

5. Martha Blair Tyler and Penelope Gregory of William Spangle and Associates, Inc., "Strengthening Unreinforced Masonry Buildings In Los Angeles: The Land Use and Occupancy Impact of L.A.'s Seismic Ordinance." Review Review Draft of February 1990.

6. Daniel J. Alesch and William J. Petak, The Politics and Economics of Earthquake Hazard Mitigation: Unreinforced Masonry Buildings in Los Angeles. Boulder: University of Colorado, Institute of Behavioral Science, 1986.

7. California Seismic Safety Commission, "Status of California's Unreinforced Masonry Building Law: A Report to the Legislature." Report No. SSC 90-03. Sacramento, CA., 1990.

8. James E. Russell, "Comparison Chart of Local Unreinforced Masonry Building Hazard Mitigation Programs as of March 1, 1990," as updated by personal communication to J. Hutton, Department of City Planning, March 14 and April 12, 1990).

9. California Seismic Safety Commission, "Rehabilitating Hazardous Masonry Buildings: A Draft Model Ordinance." Report No. SSC 85-06. Sacramento, CA., 1985.

10. The adopted UCBC amendment was being drafted during the course of the last year and a half. The available version at the time of Rutherford & Chekene's analyses for use in the EIR was version number seven, whereas the adopted version as of September 1990 may represent the twentieth draft. The UMB strengthening specifications are not substantially different between the two versions but there are important differences in the number of buildings--based on existing building characteristics--that could utilize the "special procedure" (the generally cheaper and less disruptive procedure that is based on the approach used in Los Angeles).

    It is not possible with available data to estimate the number of San Francisco's UMBs that could not be analyzed and strengthened with the proposed UCBC's "special procedure". Conservatively, it is believed that at least three-quarters of the 2007 UMBs would still be eligible for use of the "special procedure" that was analyzed for use in all UMBs as Alternative D. If the UCBC proposal is adopted in its present form, the UMBs for which the less costly "special procedure" could not be employed

include at least the following:

1) UMBs that are 7 or more stories above the base of the building (52 of the UMBs have this characteristic).

2) UMBs that have rigid diaphragms at any story level above the building's base (no available data on this characteristic).

3) Except for single story UMBs with an open front on one side only, a minimum of two lines of vertical elements of the lateral force system parallel to each axis of the building (no available data on this characteristic).

In addition to these, there may be other limitations on the use of the special procedure that are ultimately adopted in the revised provisions of the UCBC, whereas the EIR's Alternative D analyzes the construction activities and costs associated with use of the proposed UCBC (version 7) "special procedure" to all UMBs being studied.

The choice between use of Alternative D prescriptions or provisions of the UCBC provisions rests with the City's decision process. If the City selects use of the final UCBC provisions, then approximately as many as one-quarter of the UMBs would be subject to construction activity levels, duration, disruption and costs similar to those of Alternative E. In a few cases the costs and other implications may exceed those of Alternative E.

For purposes of the EIR assessment it is reasonable to assume that the impacts of a choice to adopt the final version of the UCBC code for UMB retrofits would be greater than those for Alternative D and generally less than the impacts associated with Alternative E. The effects of such a choice on casualty and damage levels have not been quantitatively estimated but can reasonably be assumed to be between those of Alternatives D and E.

11. Building Systems Development, Inc., "Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings: A Handbook." Washington, D.C.: Federal Emergency Management Agency, 1989.

12. Recht Hausrath & Associates, "Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings: Socioeconomic and Land Use Implications of Alternative Requirements," 1990. For San Francisco Department of City Planning.

III. ENVIRONMENTAL SETTING

A. LOCATION AND USE OF UMBs

San Francisco UMBs are concentrated in the northeastern portion of the City, particularly in the Downtown, North of Market (Tenderloin), South of Market, Chinatown, and Bush Street corridor (southern Nob Hill) areas. Lesser concentrations occur in the Van Ness Avenue/Polk Street corridor, the Mission district, and the east side of Potrero Hill. Table III-1 and Figure III-1 indicate the distribution of UMBs.

TABLE III-1
DISTRIBUTION OF UMBs IN SAN FRANCISCO STUDY AREAS[(a)]

Study Area	Number of UMBs	% of UMBs[(b)]
1. Downtown	343	17
2. South of Market	194	10
3. South of Market Residential	114	6
4. North of Market/Civic Center	312	16
5. Bush Street Corridor	196	10
6. Van Ness/Polk	99	5
7. Chinatown	293	15
8. North Beach	50	2
9. Waterfront	36	2
10. Mission/Upper Market	136	7
11. Outlying (all other areas)	234	12

Source: San Francisco Department of City Planning

(a) The Study Areas are illustrated on the inner back cover of the EIR.
(b) Percentages do not total 100% due to rounding.

While UMBs can be found all over the city, they are highly concentrated on certain blocks. There are about 5500 blocks in San Francisco; UMBs are located on 504 blocks, of which 234 blocks contain just one UMB. About 25% of all the UMBs are located on 24 blocks, and about one-half are located on 73 blocks.

Slightly over one-half of all the UMBs were built just after the 1906 earthquake (between 1906 and 1912). About 123 were constructed prior to 1906 and the balance were built by 1952, a time by which San Francisco Building

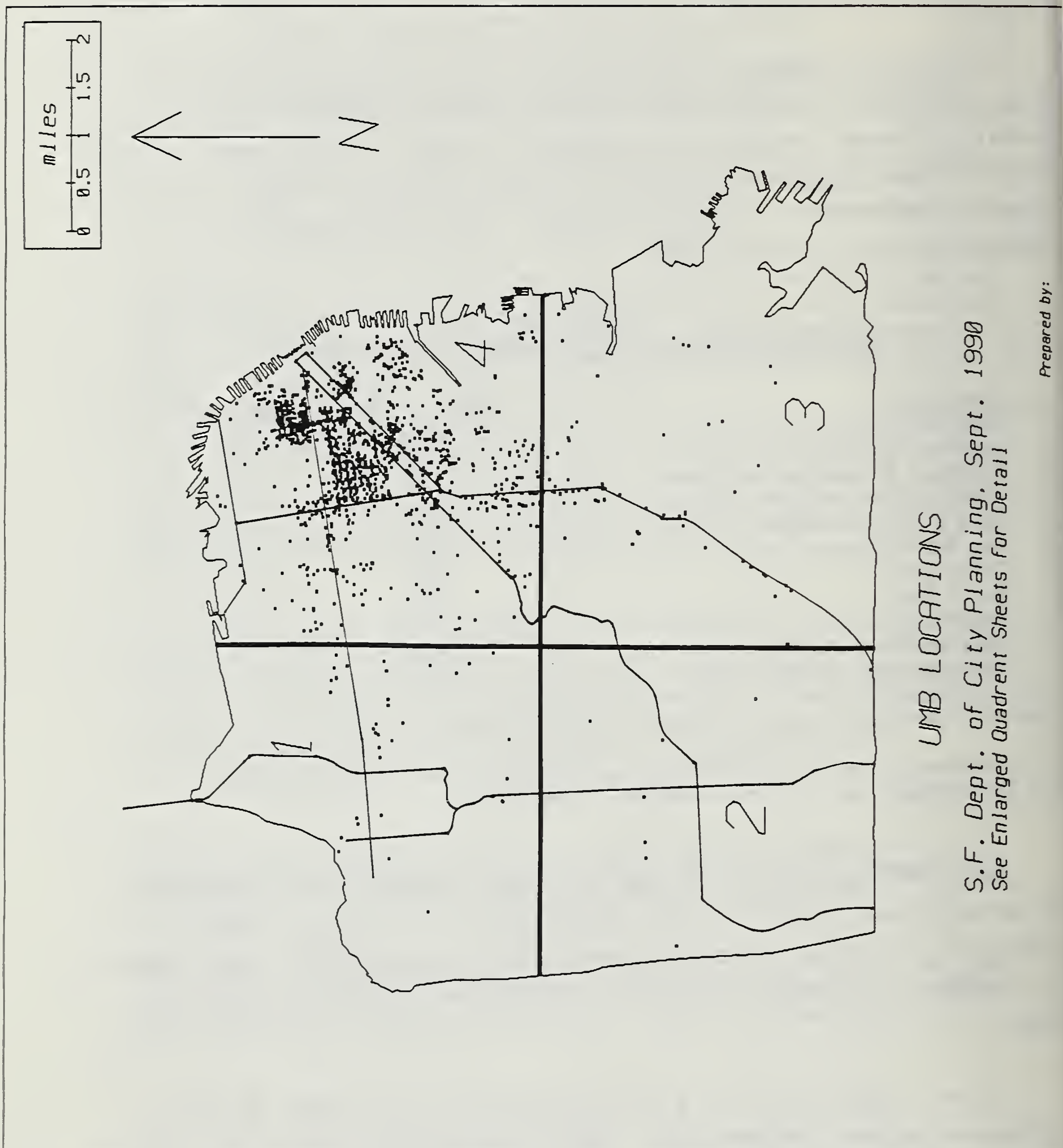


Figure III - 1 (a)

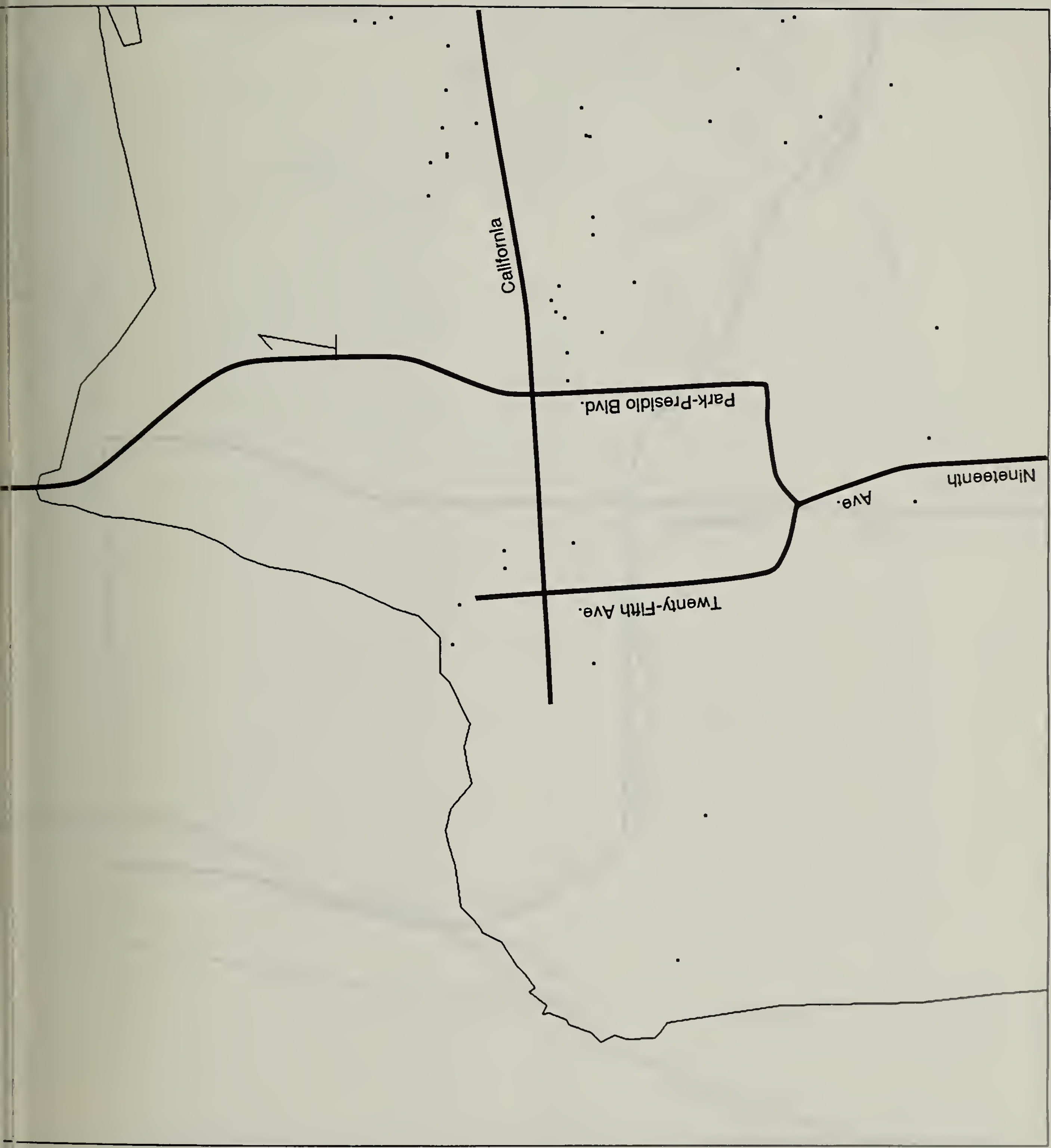


Figure III - 1 (b)

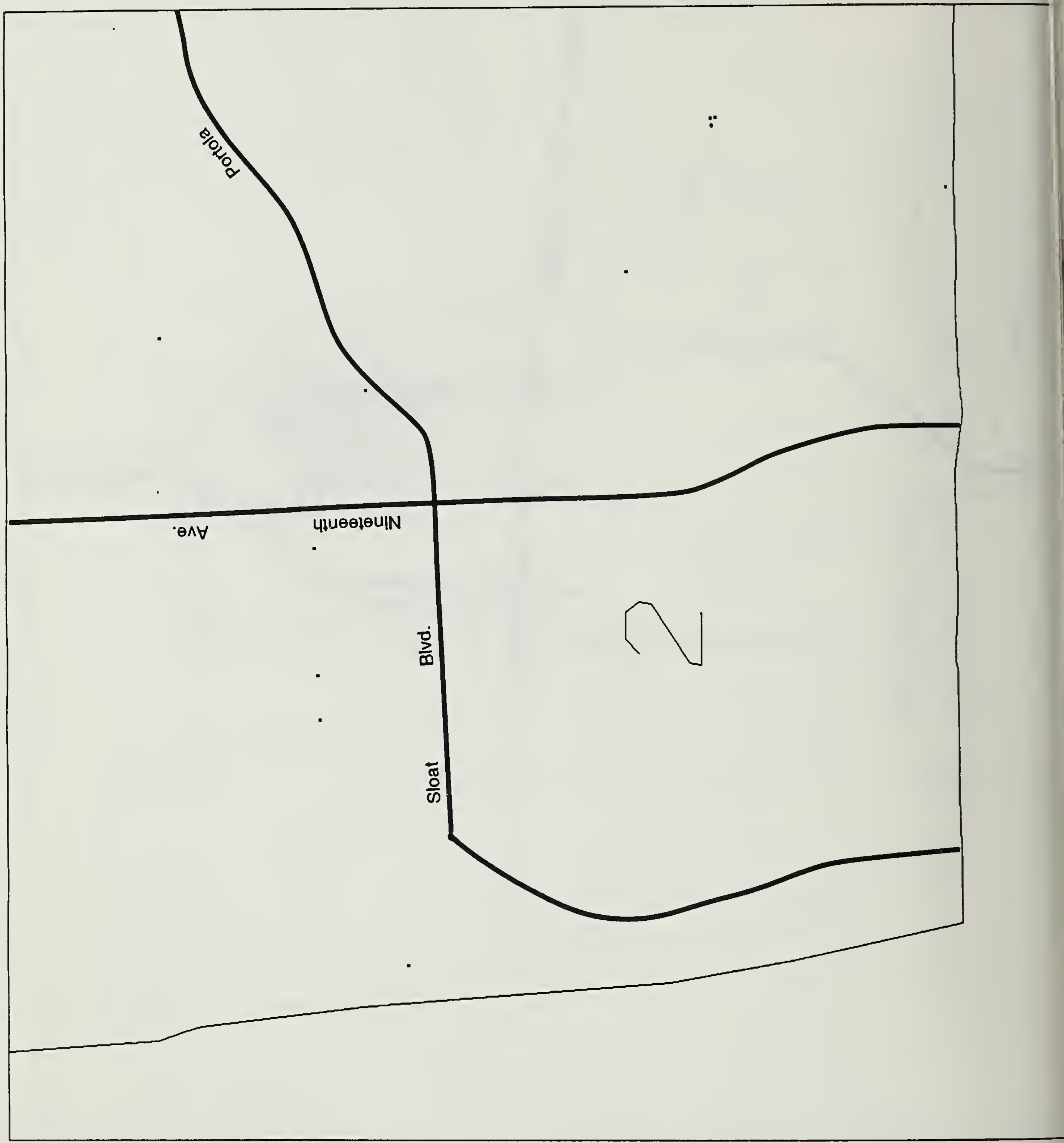


Figure III - 1 (c)

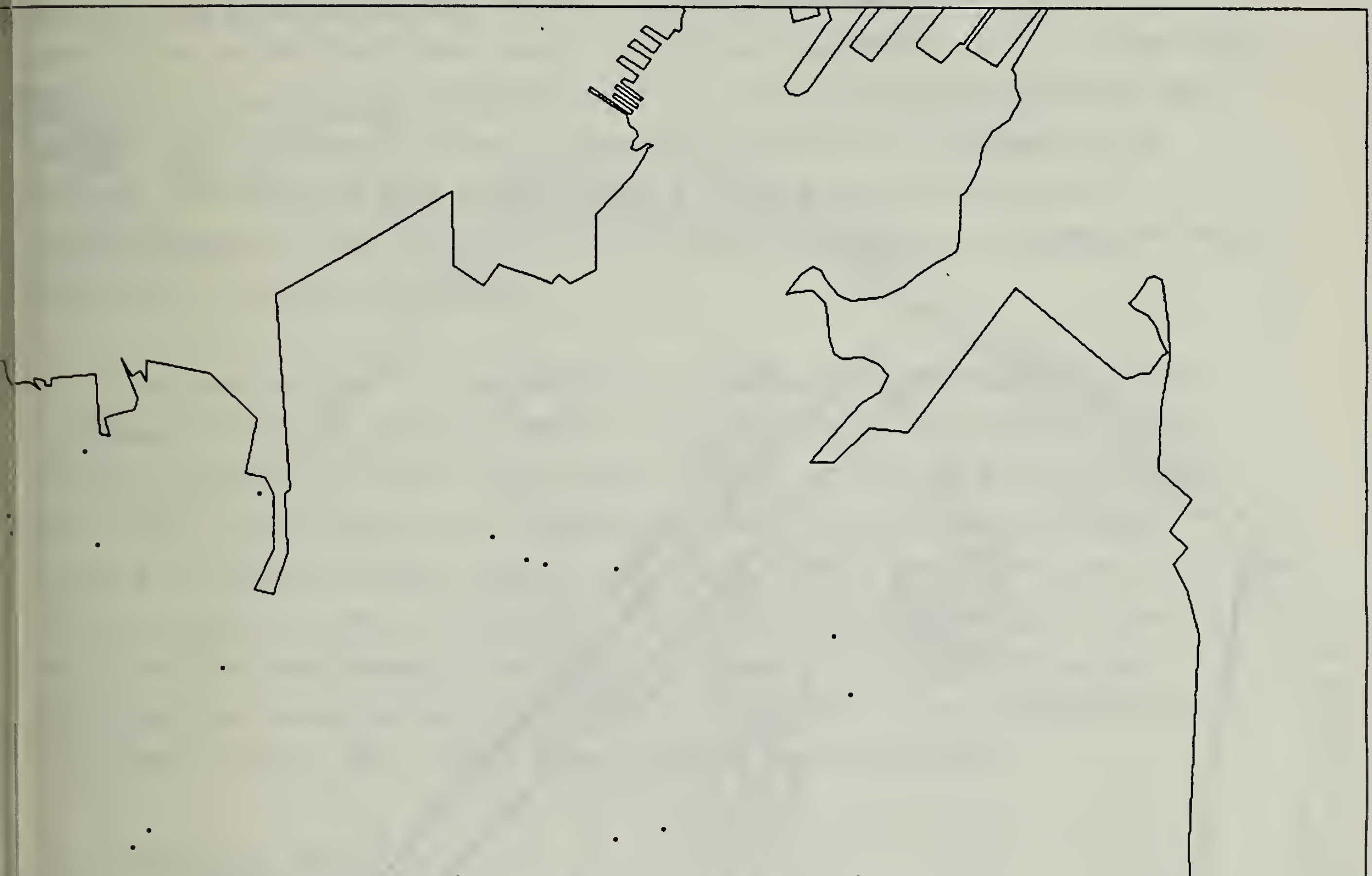


Figure III - 1 (d)

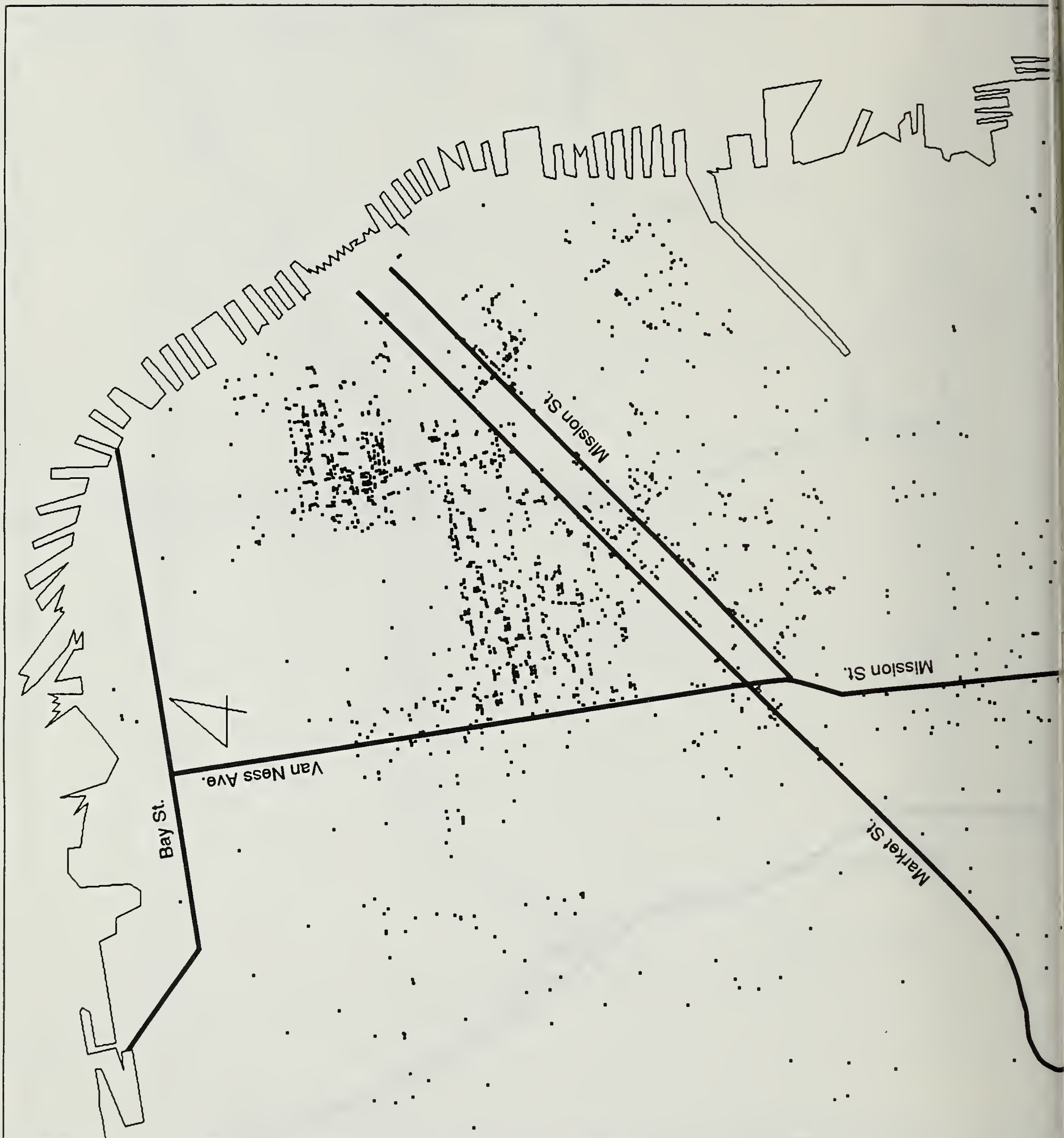


Figure III - 1 (e)

Code revisions precluded their construction. Perhaps contrary to popular belief, the City's inventory of UMBs has not diminished substantially through demolition in the last seven years. Less than one UMB per year was demolished during this period, not counting the 15 or so that were demolished due to severe damage sustained in the October 1989 Loma Prieta earthquake. An unknown but not large number (perhaps 2 to 3) are being seismically strengthened each year due to SFBC requirements triggered by changes in use or additions to existing buildings.

The range of uses in the UMBs is very wide, including moderate-sized apartment buildings, downtown retail stores, popular restaurants, Pacific Heights mansions, churches and private schools. Of the UMBs studied, about 1460 (73%) contain one or more commercial enterprises. About 800 (40%) contain at least one dwelling unit, and about 300 are purely residential. Of those containing commercial uses, approximately 440 also contain residential units and are considered " mixed use" buildings. Most of the mixed use buildings are characterized by ground floor commercial uses and upper story residential uses. Table III-2 summarizes UMBs by primary use.

1. RESIDENTIAL USES

Of the approximately 19,900 multifamily residential buildings in San Francisco, approximately three percent (658) are UMBs. However, the UMBs contain approximately 13% of the 215,000 units in these buildings. In addition, there are 130 single family UMB homes and UMBs containing one or two flats or condos. The UMBs contain approximately 21,800 residential units and an additional 5400 units classified by BBI's Division of Housing Inspection as tourist units.

The distribution of dwelling units by study area (excluding single family homes) is shown on Table III-3. Approximately 70% of these units are concentrated in three of the study areas. About one-third of the total units are located in the North of Market/Civic Center area (including the Tenderloin) with another 18% in the Bush Street Corridor area and 15% in the

TABLE III-2

APPROXIMATE DISTRIBUTION OF UMBs IN SAN FRANCISCO BY PRIMARY USE

Building Use Category	Number of UMBs	Percent of Total
Commercial Uses:		
Retail	505	25%
Office	208	10%
Converted Industrial	67	3%
Industrial/Warehouse	256	13%
Garage	72	4%
Hotel	33	2%
Theatres and Clubs	30	1%
Sub-Total	1,171	58%
Residential Uses:		
Dwellings and Flats w/o commercial	72	4%
Flats with commercial	58	3%
Apartments with commercial	223	11%
Apartments without commercial	202	10%
Residential Hotels	150	7%
Mixed Residential & Tourist Hotels	83	4%
Sub-total	788	39%
Institutional Uses:		
Churches & related	32	2%
Schools & related	12	1%
Hospitals & related	4	0%
Sub-total	48	3%
TOTALS	2,007	100%

Source: RHA 1990

TABLE III-3
TYPE AND NUMBER OF HOUSING UNITS IN UMBs
BY STUDY AREA

STUDY AREA	UMBs W/UNITS	APT (a)	SRO (a)	RESIDENTIAL SUBTOTAL	TOURIST	STUDY AREA TOTAL
1 Downtown	53	428	1,189	1,617	769	2,386
2 South of Market	10	242	132	374	71	445
3 SOMA Residential	30	176	1,284	1,460	918	2,378
4 NOMA/Civic Center	204	3,732	4,075	7,807	2,542	10,349
5 Bush Street corridor	148	3,135	827	3,962	692	4,601
6 Van Ness/Polk	44	893	281	1,174	92	1,266
7 Chinatown	192	1,037	2,247	3,284	86	3,370
8 North Beach	18	56	150	206	24	230
9 Waterfront	2	0	72	72	9	81
10 Mission/Upper Market	20	343	255	598	219	817
11 Outlying	56	937	321	1,258	57	1,315
TOTALS	777	10,979	10,833	21,812	5,426	27,238

Source: Bureau of Building Inspection, Division of Housing Inspection (HID) 1988 adjusted upward with information, as available, for buildings outside HID jurisdiction including buildings owned by non-profit organizations and assumptions made for buildings with two or fewer units (mostly identified as "flats" in the Assessor's Use Code).

(a) APT = Apartment Units
SRO = Single-Room Occupancy Units (Residential Hotels)

Chinatown Study area. Almost one-half of the tourist units (47%) are located in the North of Market/Civic Center area with most of the others distributed in the three study areas of South of Market-Residential (17%), Downtown (including Union Square area) (14%), and the Bush Street corridor (12%).

2. NON-RESIDENTIAL USES

San Francisco UMBs contain about 4500 commercial enterprises, most of which are relatively small. The businesses are concentrated in Downtown (26%), South of Market (16%), Chinatown (13%), and North of Market (11%). Detailed use classifications are known for about 1800 of them; figures indicate that nearly one-half (about 850) are retail stores, of which about 275 are eating and drinking places; 280 provide personal or business services; 127 are industrial concerns; 116 are organizations such as civic and social associations, churches, and social services; and 71 are engaged in wholesale trade. Table III-4, next page, shows the most common types of businesses in UMBs.

The number of jobs in the UMBs is estimated at approximately 46,000, based on employment density factors provided by RHA and use and square footage data from the San Francisco Assessors files./1/ These jobs represent approximately eight percent of the 587,000 total jobs in San Francisco. The estimated employment by type of use is given in Table III-5, next page.

Forty-eight of the UMBs are classified as institutional uses (two hospital accessory UMBs, 32 religious uses, 3 residential care facilities, and 11 private school/day care uses). Of the 14 UMBs that contain schools (three in churches), ten serve elementary school children (approximately 2800 students), two are senior high schools serving 180 students, one serves 40 students in vocational training and one serves 90 pre-school children.

TABLE III-4
MOST COMMON TYPES OF BUSINESSES IN SAN FRANCISCO UMBs

Business Type	Number in UMBs[a]	Percentage of Known Businesses
Eating places	234	13%
Food stores	141	8%
Clothing stores	88	5%
Home furnishings stores	57	3%
Gift shops	46	3%
Beauty parlors/barber shops	43	2%
Drinking places	40	2%
Miscellaneous retail stores	40	2%
Civic & social associations	40	2%
Auto repair shops	39	2%
Legal services	38	2%
Jewelry stores	37	2%
Commercial printing	33	2%
Religious organizations	32	2%

Source: San Francisco Department of City Planning, based on utility meter reports from PG & E

[a] Total Number of businesses for which business type is known: 1791

TABLE III-5
ESTIMATED EMPLOYMENT IN UMBs BY TYPE OF BUILDING USE

USE	EMPLOYEES
Commercial[a]	19,942
Office	12,795
Commercial-Industrial	2,851
Industrial/Warehouse	7,004
Garage	508
Institutional	1,863
Hotels	1,068
TOTAL	46,031

Source: RHA 1990

[a] Includes commercial uses in predominantly residential buildings

B. GEOLOGY/SEISMIC HAZARDS

No active faults are known to exist within San Francisco, but several are nearby. These include (at their closest distance to downtown) the San Andreas fault, about nine miles southwest of downtown; the Hayward fault, about nine miles northeast of downtown; the Seal Cove-San Gregorio fault, about 20 miles west of downtown; the Calaveras fault, about 22 miles east of downtown; the Concord Fault, about 25 miles northeast of downtown; and the Rodgers Creek fault, about 25 miles north of downtown. Both the San Andreas and Hayward faults have histories of earthquake activity affecting San Francisco. Studies of seismicity in California and other areas where major tectonic plates meet indicate that comparatively higher levels of seismic activity occur before great earthquakes, but diminish afterward; that is, there is an historic pattern of large and major earthquakes clustering before a great earthquake./2/ After the 1906 earthquake (and a sizable R 6.5 in 1911), there was a long period of low seismic activity until the mid-1950's, but since that time there has been increasing seismic activity in northern California. During the ten years since 1979, there have been four magnitude R 6.0 or greater Bay Area earthquakes whereas in the previous 68 years there had been none. This knowledge and other scientific information have led the United States Geological Survey to estimate that the probability of a major earthquake (R 7.0 or larger) affecting San Francisco sometime during the next 30 years is 67%, or 2:1.

Groundshaking intensity caused by earthquakes is the major cause of damage to the built environment. The large earthquakes most expected in the S.F. Bay Area during the next 30 years--R 7.0 earthquakes on four fault segments--would cause considerably more ground shaking in San Francisco than the October 17, 1989 Loma Prieta earthquake. These anticipated earthquakes and the respective amount of shaking they would cause in San Francisco are: 1) Hayward fault-Northern segment--five times greater shaking than the Loma Prieta earthquake; 2) Hayward fault-Southern segment--three times greater shaking; 3) Rodgers Creek fault--two times more shaking; and 4) San Andreas fault-peninsula segment--four times more shaking./2/ At particular locations,

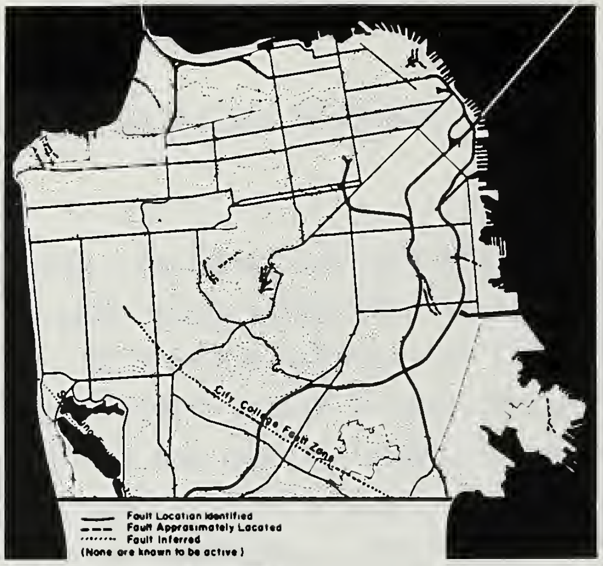
the level of groundshaking would be even stronger because of the underlying geologic materials.

In both the 1906 and 1989 earthquakes, liquefaction and rapid subsidence in San Fracisco caused buildings to settle and crack, and water mains, pipes and underground utilities to break in areas that were constructed on fill (especially the San Francisco Bay waterfront, the foot of Market Street area, the Marina district and the South of Market area). Local streets and curbs buckled or cracked from lateral spreading caused by liquefaction or rapid subsidence. The areas in San Francisco that sustained the most damage in the Loma Prieta earthquake were essentially the same as those that were subject to the most violent shaking in the 1906 earthquake.

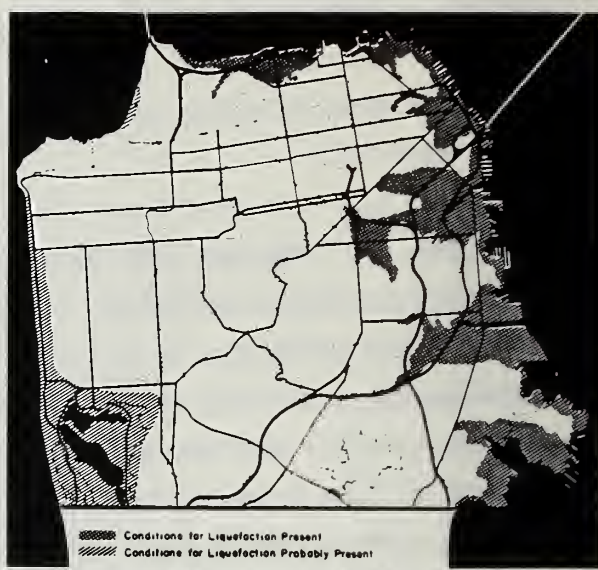
Certain types of buildings are also more susceptible to high levels of earthquake damage than others. Numerous studies in California and elsewhere strongly indicate that UMBs, as a class, are the buildings most likely to sustain the types of damage that are life threatening to occupants and passersby in even moderate earthquakes./3/ It is in response to this knowledge that the City is considering a mandate to strengthen these buildings.

1. EARTHQUAKE HAZARDS

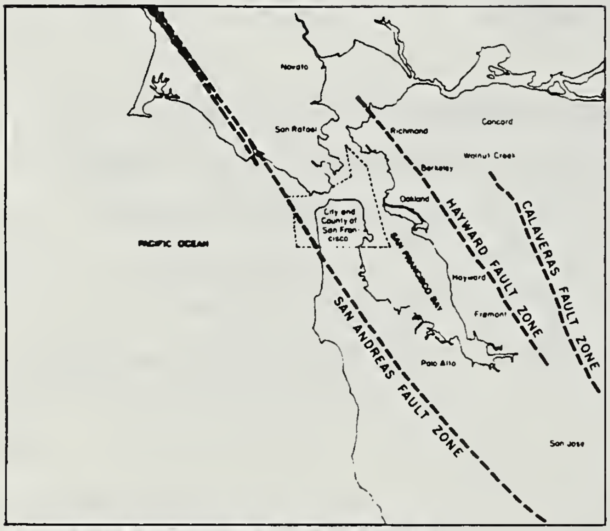
Many of the losses associated with earthquakes results from hazards that are generated by earthquakes. These hazards are described below and shown in Figure III-2. San Francisco's exposure to additional seismic hazards is also high. Ground shaking is the most obvious effect of an earthquake. The intensity and damage potential of ground shaking is mainly a function of the type of soils involved and specific characteristics of a particular earthquake. Ground shaking will be most intense on non-engineered or poorly engineered landfill and least intense on bedrock. In addition to ground shaking, liquefaction of soils can occur during an earthquake and was responsible for much of the damage in San Francisco in both the 1906 and 1989 earthquakes. Liquefaction is a form of ground failure which occurs when areas that are underlain by thick deposits of water-saturated unconsolidated sand



FAULT LOCATION IDENTIFIED

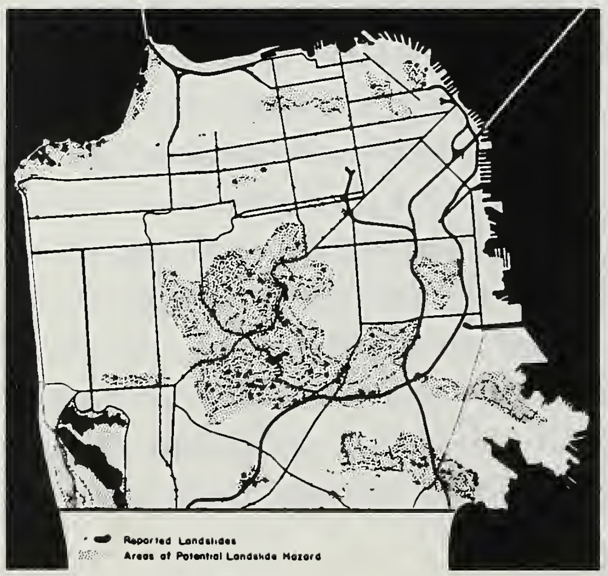


POTENTIAL LIQUEFACTION HAZARD AREAS



ACTIVE FAULTS IN SAN FRANCISCO BAY AREA

POTENTIAL SUBSIDENCE HAZARD AREAS



POTENTIAL LANDSLIDE AREAS

POTENTIAL INUNDATION AREAS DUE TO RESERVOIR FAILURE

Figure III - 2 Earthquake Hazards In San Francisco

Source: Community Safety Element of the San Francisco Master Plan, 1974

and mud become liquefied during strong seismic shaking. This can cause structures to tilt or sink, and may result in partial or total collapse. The potential for damage is compounded by the fact that loose soils of this type tend to greatly amplify the ground shaking. The Loma Prieta earthquake dramatically demonstrated that certain types of poorly engineered or unengineered landfill, such as that underlying portions of the Marina District, can fail at much lower levels of seismic shaking than had previously been predicted./10/ Areas of San Francisco subject to liquefaction are located around the City's perimeter and in areas where creekbeds have been covered over for development, as shown in Figure III-2. They include portions of Bayview-Hunters Point, China Basin, Fisherman's Wharf, India Basin, the Marina, the Financial District and about half of the South of Market Area. The same general areas are subject to subsidence (ground sinking due to settlement) during an earthquake. Subsidence occurs in loosely compacted soils and is often caused by liquefaction. It is the principal cause of underground utility line breaks.

Other possible hazards resulting from an earthquake in San Francisco include unchecked fires that could lead to uncontrolled conflagration; hazardous material releases; reservoir failure; landslides; and tsunamis. The City has a post-earthquake fire risk three to four times higher than the Bay Area as a whole./4/ In a 1987 study of fires following earthquakes it was estimated that a magnitude 8.3 earthquake could generate approximately 75 fires that would be of sufficient size to require San Francisco Fire Department response. Most of the fires would be caused by broken gas lines. Under windless conditions, 58 of the fires would be too large for a single engine company to suppress and a total of 142 engine companies would be needed to suppress the fires. In a 10-mile per hour wind 71 of the 75 fires would be too large for a single engine company and 273 engine companies would be needed./4/ The City has 41 engine companies plus 12 engines (many of which are inoperative) in reserve.

During the October 17, 1989 earthquake, the low-pressure domestic water supply system mains ruptured in 150 locations. Water main ruptures can be

expected in future major earthquakes, particularly in those areas of the City which are prone to liquefaction and subsidence.

An earthquake-generated release of hazardous material into the environment could cause a multitude of problems. Although hazardous material incidents can happen almost anywhere, certain areas are at higher risk./5/ Facilities using hazardous materials are somewhat concentrated in the eastern part of the City where most industrial uses are located. The City contains major transportation arteries on which are transported hazardous or potentially hazardous materials on a regular basis. Highways U.S.-101 and I-280, Third Street and the railroads are the most likely routes for transportation of hazardous materials through San Francisco. Following a large earthquake far fewer resources would be available to deal with a hazardous material emergency.

Figure III-2 shows the seven reservoir sites subject to dam failure during an earthquake. The estimated number of persons at risk of drowning in the event of failure of individual reservoirs ranges from under 1000 persons (Sutro Reservoir) to over 14,000 persons (North Basin of the Sunset Reservoir)./5/

Landslide-prone areas in San Francisco are shown on Figure III-2. Major cross-town arteries such as Seventh Avenue, Laguna Honda, O'Shaughnessy Boulevard may become blocked by landslides as a result of an earthquake. In most cases, alternative routes exist.

Tsunamis are sea waves produced by a large-scale, sudden disturbance on the ocean floor. Submarine earthquakes are the most common cause. The 1906 earthquake apparently did not generate a tsunami/6/ but there remains considerable uncertainty over the extent of tsunami runup which could occur./7,8,9/ A seiche is a rare oscillation of the surface water in an enclosed basin, such as a bay or lake, caused chiefly by local changes in atmospheric pressure aided by winds or an earthquake. The most likely generating mechanism for a seiche in San Francisco Bay is motion along one of

the major faults in the Bay area. However, a major earthquake is not expected to cause a destructive seiche in the Bay./6/

2. LEVEL OF HAZARD

Earthquake risk is the chance or probability that an earthquake will occur and cause damage to people and their property. Earthquake risk in a community is determined generally by three factors, as follows: 1) geophysical characteristics, involving magnitude and location, intensity of an earthquake coupled with its triggering of secondary hazards such as fires, landslides, soil failure and flooding (from tsunami inundation or dam failure); 2) human use characteristics of the earthquake-affected area including consideration of buildings and other structures and factors such as population density and distribution; and 3) the set of actions that the community and individuals have taken to avoid or reduce earthquake risks. The first two factors determine the exposure to the earthquake risk and the latter determines how much of that risk is avoided or reduced.

Generally speaking, the level of earthquake hazard in San Francisco has to be considered high; there is a substantial level of exposure and insufficient resources have been specifically directed to reducing the risk to life and property. The Community Safety Element of San Francisco's Master Plan (currently being revised) contains policies which seek to minimize life safety hazards, property damage and economic dislocations due to earthquakes. Objective 1, Policy 2 is to "install an orderly abatement of hazards from existing buildings and structures." Objective 7, Policy 4, is to "require geologic or soil engineering site investigations, and compensating structural design based on findings, for all projects in special geologic study areas." Objective 1, Policy 5 is to "modify permitted land uses and types of structures, where appropriate, according to geologic factors and consistent with levels of acceptable risk."

In addition to these policies the City has several ongoing programs and practices intended to reduce earthquake related hazards. These are summarized

in this EIR, Section II.B. These ongoing programs and policies are intended to minimize injury and loss of life in an earthquake, for both current and future residents, workers and visitors in San Francisco.

A summary of effects of the recent Loma Prieta earthquake of October 17, 1989 and estimates of losses of life and property that are associated with the 2007 UMBs will illustrate the high hazard level in the City.

3. SUMMARY OF THE LOMA PRIETA EARTHQUAKE EFFECTS

The October 17, 1989 Loma Prieta earthquake struck at 5:04 pm and registered 7.1 on the Richter Magnitude scale. The earthquake was located on the San Andreas fault system in the southern Santa Cruz Mountains near the summit of Loma Prieta Mountain. The epicenter was about 9 miles northeast of Santa Cruz, 20 miles south of San Jose, approximately 60 miles south of San Francisco. There was light damage as far away as Sonoma County and downtown Sacramento. The peak value on the Modified Mercalli Index (MMI) was IX (see glossary for scale definitions). In San Francisco, MMIs of IX were assigned in the Marina District, but a typical range for the city was generally much lower, from VI to VII.

Bridge and viaduct damage was extensive, including the collapse of the two-level Cypress section of the Interstate 880 freeway in Oakland that killed 42 people, and the failure of a portion of the Bay Bridge that killed one person and shut down the bridge for over a month. Other transportation routes were closed temporarily or indefinitely. There was damage to structures in nearly all of the areas that felt the earthquake, and there was serious damage to many buildings in Hollister, Los Gatos, Oakland, Santa Cruz, San Francisco and Watsonville, particularly in downtown UMBs and older wood frame residential structures. Total dollar estimates of losses vary, but they have been variously reported as ranging between 6.5 and 10 billion dollars.

Aside from the Cypress collapse, there were 20 other lives lost, bringing the total to 62. The State Office of Emergency Services indicated 3,757

injuries were treated at hospitals or Red Cross shelters. The California Association of Hospitals and Health Services reported 3,000 emergency room treatments and 430 injuries requiring hospital admittance. By comparison, there were approximately 700-800 deaths in the 1906 San Francisco earthquake, and 58 deaths and approximately 2,000 injuries in the 1971 San Fernando earthquake. Of the 62 Loma Prieta fatalities, 8 were related to UMBs. Five people died at Sixth and Bluxome Streets in San Francisco when the top story of a UMB fell outward to the street and crushed them. In Santa Cruz, the parapet on one UMB fell and killed a pedestrian, and a portion of the top story wall of another UMB fell through the wood roof of an adjoining building, crushing two workers.

(1) San Francisco UMB Damage Assessment. While the damage to San Francisco UMBs was not as severe as it was in cities close to the epicenter such as Santa Cruz or Watsonville, there was enough to warrant extensive assessment and data collection. The San Francisco Bureau of Building Inspection coordinated damage assessment inspections of UMBs conducted by 100 to 200 different inspectors. The background of these inspection teams varied from visiting building department personnel with no earthquake experience to volunteer licensed structural engineers. The damage rating form used three damage classifications:

Posting	Color	Description
INSPECTED	Green	No apparent hazard found, although repairs may be required. Original lateral load capacity not significantly decreased. No restriction on use or occupancy.
LIMITED ENTRY	Yellow	Dangerous condition believed to be present. Entry by owner permitted only for emergency purposes and only at own risk. No usage on continuous basis. Entry by public not permitted. Possible major aftershock hazard.
UNSAFE	Red	Extreme hazard, may collapse. Imminent danger of collapse from an aftershock. Unsafe for occupancy or entry, except by authorities.

Of the 1,970 UMBs surveyed, Bureau of Building Inspection records indicate that there were 40 red tags, 219 yellow tags, and the remainder, green tags. By comparison, the city's total building stock is over 100,000 buildings. BBI's records indicate that there were 427 red tags, 2,110 yellow tags and 8,024 green tags. These data show that 13% of the UMBs were sufficiently damaged to warrant red or yellow tags whereas less than two percent of other San Francisco buildings sustained that amount of damage, including all those in the Marina District.

Information was obtained from a second, supplementary damage survey form for 1,935 UMBs. Based on this information, the preliminary totals for certain types of damage are listed below. A building may have sustained more than one type of damage.

Type of Damage	Number of Affected San Francisco UMBs	Percent of San Francisco UMBs Surveyed (1935 UMBs)
Falling Individual Units or Trim	103	5
Veneer or Delamination Failure	101	5
Parapet Failure	99	5
Portion of Wall Failure	61	3
Entire Wall Failure	36	2
Type of Cracking Damage		
Corner of Openings	253	13
"X" Cracking of Spandrels	125	6
Vertical Cracks at Spandrel Edges	181	9
"X" Cracks in Piers or Walls	204	11
Horizontal Cracks at Top/Bottom of Pier	202	10
Corner Distress at First Level	167	9
Corner Distress above First Level	170	9
Other Types of Damage		
Damage from Debris from Adjacent Building	7	<1
Roof or Floor Failure Due To Movement of Exterior Wall	13	<1

For the 1,970 UMBs in San Francisco with damage ratings, the effects of various building attributes on the losses experienced in the Loma Prieta earthquake were examined by the following attributes: prototype, building

use, number of stories, building plan shape, diaphragm ratio, average story height, number of reentrant corners, soft story, parapet status, year built, and ABAG geology code. The analysis confirmed engineering observations that soil conditions have the greatest impact on building damage. The poorer the soil, the more building damage resulted. In fact, the influence of soil conditions was strong enough that more subtle variations in damage caused by other attributes were not apparent.

Following the earthquake approximately 15 UMBs were demolished and approximately 20 more are closed for an indefinite period of time while analysis of options and financing decisions are being made.

C. ARCHITECTURAL AND HISTORIC RESOURCES

As indicated in Table III-6, approximately one-quarter (528) of the UMBs were built within the 16 months following the 1906 earthquake and slightly more than one-half (1060) were built less than six years after that quake. Ninety-nine percent of the UMBs were built over 55 years ago. Because of their age and the time period in which most were built, San Francisco UMBs as a class have a high degree of historical and architectural interest.

TABLE III-6
AGE OF UMB BUILDING STOCK

YEAR BUILT	NO. UMBs	% OF TOTAL UMBs	CUMULATIVE TOTAL OF UMBs NO.	%
Before 1906	123	6	123	6%
1906-1907	528	26	651	32%
1908-1911	532	27	1183	59%
1912-1933	797	40	1908	99%
1934-1950[a]	27	1	2007	100%

Source: San Francisco Department of City Planning.

(a) Although the SFBC did not preclude UMB construction until 1948, few of the existing UMBs (27) were built in San Francisco after the Long Beach earthquake of 1933, in which UMBs performed poorly.

Existing information on their architectural/historic merit and protection status is available for approximately 85% (1617) of the UMBs. This information, summarized below, is based on several detailed, referenced surveys. Subsequent additions to this data base for the remaining UMBs about which no architectural/historical information is known will be made in the near future as a result of an ongoing DCP architectural inventory study of the UMBs, funded by the State of California, Department of Parks and Recreation, Office of Historic Preservation.

1. Applicable Regulations And Policies.

San Francisco currently has four basic regulatory mechanisms to encourage preservation of architectural and historic resources:

(1) The San Francisco City Planning Code, Article 10;
(2) The San Francisco City Planning Code, Article 11;
(3) Policies that encourage historic preservation in certain Area Plans of the Master Plan; and
(4) Priority Policy Number 7 in Section 101.1 of the San Francisco City Planning Code (Proposition M).

In addition to these adopted regulatory mechanisms, the Department of City Planning has released a Preservation Element, Proposal for Citizen Review, which if adopted would become part of the Master Plan. As proposed, the Element would generally strengthen and clarify available protections for designated buildings of significance.

Each of these mechanisms provides guidelines or policies that differ somewhat from one another in the degrees of protection they provide but each sets forth as its basic purpose the recognition and preservation of important examples of the City's architecture and/or history. The applicability of these four provisions to the listed UMBs is described in more detail below.

a. City Planning Code, Article 10. Article 10 establishes the Landmarks Preservation Advisory Board (LPAB) and procedures for designating City Landmark buildings and Historic Districts. City Landmarks and buildings located in historic districts designated by an ordinance appended to Article 10 are subject to LPAB review for either an application for a permit to perform a substantial alteration of the building or a permit to demolish a building. In either case, the City Planning Commission must issue a Certificate of Appropriateness for the permit to be approved, based on a recommendation from the LPAB and Department of City Planning. The City can delay a demolition permit for up to six months with a possible additional 6-month delay by the Board of Supervisors to explore methods to preserve the structure (up to nine months for buildings within historic districts).

In considering the compatibility of proposed major alterations, the LPAB uses criteria adopted in Article 10 that are based on the Secretary of the Interior's Standards for Rehabilitation. In some cases, the designating ordinance for each historic district provides additional guidance.

Information is provided below about the number and distribution of the UMBs subject to the provisions of Article 10.

(1) City Landmarks. Article 10 provides for the designation of structures, sites and areas of special character or historical, architectural or aesthetic interest as City Landmarks. Proposed major alterations and demolition permit applications affecting City Landmarks require review by the LPAB and the Planning Commission, as indicated above.

To date, 42 listed UMBs are designated City Landmarks; more than half of these are in the Downtown Study area. These 42 represent approximately 20% of the City's Landmarks as of October 1990. City Landmark UMBs are listed in Table III-7.

(2) Historic Districts. Article 10 (Sec. 1004) authorizes the Board of Supervisors to adopt ordinances that designate an area containing a number of

TABLE III-7
UMBs DESIGNATED AS CITY LANDMARKS

Block	Lot	Address
10	2	680 Beach St.
131	9	624 Vallejo St.
136	3	915 Front St.
140	5	60 Broadway
141	13	855 Front St.
175	10	470 Jackson St.
175	10	472 Jackson St.
175	12	800 Montgomery St.
175	4	701 Sansome St.
175	7	432 Jackson St.
175	9	468 Jackson St.
195	2	36 Columbus St.
196	13	722 Montgomery St.
196	14	726 Montgomery St.
196	15	730 Montgomery St.
196	17	463 Jackson St.
196	18	42 Hotaling Pl.
196	19	451 Jackson St.
196	20	443 Jackson St.
196	21	435 Jackson St.
196	22	407 Jackson St.
196	22	415 Jackson St.
240	14	615 Sacramento St.
241	12	614 Grant Av.
269	3	350 Bush St.
271	24	566 Bush St.
294	1	303 Sutter St.
309	19	140 Maiden Lane
316	1A	333 Mason St.
333	12	380 Eddy St.
349	12	133 Golden Gate Av.
452	1	900 North Point St.
459	3	3640 Buchanan St.
580	13	2550 Webster St.
587	27	2428 Jackson St.
720	28	1135 O'Farrell St.
3517	35	1401 Howard St.
3588	82	3541 18th St.
3706	68	748 Mission St.
3789	15	622 1st St.
3799	1	700 7th St.

structures having a special character or special historical, architectural or aesthetic interest or value, and constituting a distinct section of the City, as an historic district. Based on a systematic survey of the buildings located within the boundaries of a district study area, buildings are given one of the three following ratings: Contributory to the district's theme; Contributory Altered (where the possibility exists for rehabilitating the building to the original, contributory condition); or Non-contributory (outside the period of significance or too altered to be rehabilitated).

To date (October 1990), Article 10 applies to seven historic districts; six of these contain at least one UMB, as shown in Table III-8. Table III-8 shows the distribution of ratings for the UMBs for each of these historic districts. Of the 108 UMBs located within these districts, 104 are rated as Contributory or Contributory Altered; four are rated as Non-contributory. An additional 21 UMBs are City Landmarks (not located in historic districts). A total of 129 UMBs are subject to the provisions of Article 10.

(3) Proposed Historic Districts. Over the last few years, the Department of City Planning has evaluated buildings having architectural or historic merit in the context of several potential historic districts. As of October 1990, three of these have been approved by the LPAB for consideration by the City Planning Commission: the Buena Vista North Historic District, the Civic Center Historic District and the Chinatown Historic District. Table III-9 shows the distribution of the UMBs included in these proposed districts by their proposed ratings. As indicated in Table III-9, approximately 13% of all UMBs are located within these proposed historic districts, the vast majority in Chinatown. At the present time, these buildings would not be subject to review under provisions of Article 10. For purposes of analysis in this EIR, these potential historic districts were not assumed to be adopted and implications of this assumption are considered in the impact assessment.

b. City Planning Code, Article 11. In 1985 the Board of Supervisors passed amendments to the City Planning Code implementing the Downtown Plan. The historic preservation portions of this Plan were codified as Article 11. This

TABLE III-8
RATINGS OF UMBs LOCATED WITHIN
DESIGNATED HISTORIC DISTRICTS

HISTORIC DISTRICT (YEAR ADOPTED)	RATING CATEGORY[a] "C"	"CA"	"NC"	Total
Alamo Square (1984)	1	0	0	1
Jackson Square (1972)	41	16	1	58
Liberty Hill (1985)	1	0	1	2
Northeast Waterfront (1983)	13	2	0	15
South End (1990)	27	2	2	31
Telegraph Hill (1986)	1	0	0	1
TOTALS	84	20	4	108

Source: San Francisco Department of City Planning
(a) "C" = Contributory
"CA" = Contributory Altered
"NC" = Non-contributory

TABLE III-9
RATINGS OF UMBs LOCATED IN PROPOSED
HISTORIC DISTRICTS

PROPOSED HISTORIC DISTRICT	RATING CATEGORY[a] "C"	"CA"	"NC"	TOTAL
Buena Vista North	4	0	0	4
Chinatown	204	40	11	255
Civic Center	1	1	1	3
TOTALS	209	41	12	262

Source: San Francisco Department of City Planning
(a) "C" = Contributory
"CA" = Contributory Altered
"NC" = Non-contributory

section of the Code establishes procedures to encourage preservation of buildings located in the C-3 zoning districts that have important architectural, historical and aesthetic values. The Downtown Plan EIR's Appendix E gives a detailed description of the methods used to survey and rate the architectural values of the buildings located in the Downtown Plan area./10/ All buildings in the C-3 Districts were assigned to one of five categories, as follows:

- Significant Building - Category I
- Significant Building - Category II
- Contributory Building - Category III
- Contributory Building - Category IV
- Unrated Building - Category V

In addition, six portions of the C-3 Districts have been designated as Conservation Districts. These districts contain substantial concentrations of buildings that together create subareas of special architectural and aesthetic importance. A total of 63 Significant Buildings are UMBs and 116 Contributory Buildings are UMBs. Of the 434 rated buildings (Categories I-IV) in the Downtown Plan area slightly more than 40% are UMBs.

Article 11 prohibits demolition of a Significant Building or a Contributory Building from which Transfer of Development Rights (TDR) has occurred, unless the owner can demonstrate that the building has no substantial remaining market value or reasonable use. Under Article 11, the Zoning Administrator shall approve any application for demolition of a Contributory Building from which no Transfer of Development Rights have been sold for use at another site. {To date, no TDRs have been transferred from any UMB in the Downtown Plan area.} The Zoning Administrator shall also approve demolition of an Unrated Building located in a Conservation District, if a building or site permit has been issued for a replacement structure on the site. Unrated Buildings that are not located in a Conservation District are not subject to the provisions of Article 11.

City Planning Commission approval is required for any permit for major alteration of a Significant or Contributory Building (Category V Buildings that are located in Conservation Districts are considered "Contributory" under this provision of Article 11). Standards used for review of compatibility for major alterations differ somewhat from those of Article 10 but they are also based on the Secretary of the Interior's Standards, and there is additional guidance for each of the Conservation Districts.

Based on information contained in Article 11, Table III-10 summarizes the distribution of ratings for the UMBs and their location, where applicable, in Conservation Districts. Almost 22% of the UMBs (433) are located in the C-3 Districts and over half of these would be subject to provisions in Article 11. Fifteen percent of these are rated Significant, 27% are Contributory and, by virtue of their location in Conservation Districts, 49 Category V UMBs (another 11%) are included in the afforded protections.

TABLE III-10
RATINGS OF UMBs LOCATED WITHIN THE DOWNTOWN AREA PLAN (C-3 DISTRICTS) AND CONSERVATION DISTRICTS

	RATING CATEGORY[a]					
CONSERVATION DISTRICT (C.D.)	I	II	III	IV	V	Total
Commercial-Leidesdorff	4	0	0	6	4	14
Front-California	2	1	0	4	5	12
Kearny-Belden	2	0	0	4	2	8
Kearny-Market-Mason-Sutter	21	6	1	70	35	133
New Montgomery-Second St.	2	0	0	16	3	21
Pine-Sansome	1	0	0	0	0	1
Subtotal in C.D.s	32	7	1	100	49	189
Located outside C.D.s	17	7	10	5	205	244
Total in C-3	49	14	1	105	254	433

Source: San Francisco Department of City Planning

(a) I and II are Significant Buildings
III and IV are Contributory Buildings
V are Unrated Buildings (Category V buildings in Conservation Districts are subject to the same Article 11 provisions as Contributory Buildings.)

NOTE: The Downtown Plan Area (C-3 District) includes a larger area, and thus more UMBs, than the Downtown UMB Study Area, which essentially covers only the core office and retail portions of downtown.

C. Other Area Plans. Based generally on the approach utilized for considering architectural and historic resources in the Downtown Plan area survey, systematic surveys of buildings were conducted for three other area plans including the Van Ness Avenue area, the South of Market area and Northeast Waterfront area. Buildings in these areas were evaluated and rated either as Significant, Contributory or Non-contributory (basically having the same meaning as Unrated in the Downtown Plan). Although less specific and restrictive than those for buildings in the C-3 Districts, these area plan amendments to the City's Master Plan also incorporate provisions to discourage demolitions of Significant and Contributory buildings. Some Plan provisions also require LPAB review and City Planning Commission approval of permits for major alterations. These area plan protections are described further below.

The Van Ness Avenue Plan (adopted in 1987) was designed to achieve four goals, one of which is to encourage preservation of buildings that have significant architectural values. During development of the plan, buildings in the Van Ness Avenue corridor were systematically evaluated and 32 buildings were identified as Significant, eight of which are UMBs. Of the 66 UMBs located in the Van Ness Avenue Plan area, 8 are rated Significant, 38 are rated Contributory and 20 are rated Non-contributory. Policies protective of architectural values are contained in the Van Ness Avenue Plan but are not codified in the City Planning Code except generally in Section 101.

During the Spring of 1990, the City Planning Commission approved amendments to the Planning Code implementing the South of Market Area Plan. Studies leading to plan development identified 14 UMBs rated Significant and warranting protection from incompatible major alterations due to their historical or architectural merit. This protection is encouraged in the Code through relaxation of parking and use restrictions for Significant Buildings in the South of Market area.

Possible amendment of the Northeast Waterfront Area Plan of the Master Plan and implementing rezoning is currently being studied. A systematic survey similar to that conducted for the Van Ness Avenue Plan is complete.

Results indicate there are three UMBs rated Significant. These are assumed in this EIR to ultimately receive the same regulatory treatment provided for Significant Buildings in the Van Ness Avenue Plan area.

D. Proposition M Review. Consistent with passage of Proposition M, Section 101.1 of the San Francisco City Planning Code incorporates the priority policy that historic buildings be preserved. Current policy applies the term "historic building" to all buildings that are designated as City Landmarks, located in city historic districts, Significant or Contributory in area plans, listed on the National Register of Historic Places, or rated in the 1976 Citywide Architectural Survey (described below). Major alteration or demolition of an historic building as defined above requires review by the LPAB. Review guidelines are consistent with federal guidelines put forth by the Secretary of the Interior to evaluate the compatibility of plans for major alterations with the goal of preserving the building's historic character.

There are 385 UMBs subject to review based on policies that implement Section 101.1 that would otherwise not be protected through Articles 10 or 11 or the previously mentioned area plan protections. These 385 comprise 378 UMBs rated in the 1976 Citywide Architectural Survey, plus seven listed on the National Register of Historic Places that are not protected through other designations.

The 1976 Citywide Architectural Survey was conducted by the Department of City Planning between 1974 and 1976. The survey (DCP '76) was conducted with the help of an advisory review committee of architects and architectural historians who assisted in the final determination of ratings for the 10,000 buildings included in the survey. These ratings were entered in an unpublished 60-volume record of the inventory (available for public inspection through retrieval by Zoning Counter Staff at the Department of City Planning, 450 McAllister St., 5th floor, or by appointment only with the Secretary of the Landmarks Board, 4th floor).

The inventory assessed the architectural significance of the surveyed

structures from the standpoint of overall design and particular design features. Historical factors were not considered. Both contemporary and older buildings were included, and each building was numerically rated according to its overall architectural significance. The ratings ranged from a low of "0" to a high of "5". Factors considered included architectural significance and urban design context. The architectural survey resulted in a listing of the best ten percent of San Francisco's buildings. In the estimation of the inventory participants, buildings rated "3" or higher represent approximately the best two percent of the City's architecture.

Table III-11 shows, by study area, the DCP'76 ratings for the 571 UMBs included in the survey. Of the listed UMBs, 141 (7%) were rated "3" or higher and are considered to be among the best two percent of the City's architecture.

2. Heritage Surveys

The most comprehensive available data on the architectural/historical merit of UMBs are the building ratings provided by The Foundation for San Francisco's Architectural Heritage (Heritage). The Downtown Plan EIR describes in detail the evaluation methods utilized by Heritage in its surveys/10/. Generally, the buildings are assigned a rating of A, B, C, D or N where "A" represents highest importance; "B" represents major importance; "C" represents contextual importance; "D" represents minor or no importance and "N" means non-rated (usually a building with "N" is not yet old enough to be considered of importance). Heritage has rated 72% (1451) of the UMBs, as shown on Table III-12 by Study Area. As indicated on the table, over half of the UMBs lacking Heritage ratings are located in either the Mission/Upper Market area or in the Outlying area.

Currently information is being compiled and analyzed by the DCP so that an evaluation of these UMBs, including an evaluation of their relative architectural and/or historic significance, can be completed and made and available for use in the future. As these evaluations become available they

TABLE III-11
DISTRIBUTION OF 1976 CITYWIDE ARCHITECTURAL
SURVEY RATINGS BY STUDY AREA

STUDY AREA	RATING CATEGORY[a] 0	1	2	3	4	5	TOTAL RATED	UNRATED	STUDY A[REA] TOTALS
Downtown	20	46	39	19	18	4	146	197	343
South of Market	5	13	6	8	3	0	35	159	194
SOMA Residential	4	7	2	3	0	0	16	98	114
NOMA/Civic Center	15	33	26	7	3	1	85	227	312
Bush Street Corridor	18	29	18	5	1	0	71	125	196
Van Ness/Polk	4	6	2	3	2	0	17	82	99
Chinatown	6	19	17	21	3	0	66	227	293
North Beach	3	9	6	1	3	0	22	28	50
Waterfront	1	5	10	4	2	0	22	14	36
Mission/Upper Market	1	10	7	3	1	0	22	114	136
Outlying	8	13	22	13	10	3	69	165	234
TOTALS	85	190	155	87	46	8	571	1,436	2,007
PERCENT OF ALL UMBs	4%	9%	8%	4%	2%	<1%	28%	72%	100%

Source: San Francisco Department of City Planning

(a) Where "5" is highest rated and "0" is lowest rated.

TABLE III-12
DISTRIBUTION OF HERITAGE RATINGS
BY STUDY AREA

	RATING CATEGORY[a]						
STUDY AREA	A	B	C	D	N	UNRATED	ROW TOTALS
Downtown	17	57	207	46	0	16	343
South of Market	5	25	87	11	0	66	194
SOMA Residential	3	12	67	19	2	11	114
NOMA/Civic Center	6	60	206	35	0	5	312
Bush Street Corridor	9	39	128	8	0	12	196
Van Ness/Polk	2	7	17	2	0	71	99
Chinatown	16	45	200	8	0	24	293
North Beach	1	3	35	3	0	8	50
Waterfront	0	7	16	4	0	9	36
Mission/Upper Market	0	3	11	0	0	122	136
Outlying	3	8	11	0	0	212	234
TOTALS	62	266	985	136	2	556	2,007
PERCENT OF ALL UMBs	3%	13%	49%	7%	<1%	28%	100%

Source: San Francisco Department of City Planning

(a) A = highest importance
B = major importance
C = contextual importance
D = minor or no importance
N = non-rated (usually not yet old enough to be considered)

will be added to the UMB data base so they can be considered in subsequent decision making processes, including possible regulations to encourage their preservation and retention of architectural features that contribute to their significance.

3. Summary Of Existing Information.

Table III-13 provides a synthesis and summary of what is known to date about the architectural/historic resources and regulatory protection of the UMB study population. The first column of the table indicates whether the type of rating mentioned is associated with a requirement for automatic LPAB review of permit requests for either demolitions or major alterations. The second column provides the number of UMBs with that rating status. The third column gives the cumulative total of UMBs for which the Planning Code or other policies provide for automatic LPAB review and encouragement for protection of architectural/historic resources.

There are 794 UMBs (40% of the study population) that are clearly subject to regulation due to architectural/historical merit, as provided by the Planning Code and/or existing policy. Of these (and accounting for duplication of protection), 129 UMBs are covered by Article 10, another 221 by Article 11, another 59 by Area Plans, and another 385 by Section 101.1 of the Planning Code.

An additional 183 UMBs that are not already protected by one of these regulations or policies have been identified in proposed historic districts that are under consideration for inclusion in Article 10. Of these, nearly all (180) UMBs are located within the potential Chinatown Historic District and rated either Contributory or Contributory Altered. The associated amendments to Article 10 have been drafted and approved by the LPAB but have not been forwarded to the Planning Commission for its consideration as of October 1990. The LPAB and City Planning Commission have the discretionary authority to review any alteration or demolition permit which could impact an architectural or historical building resource. Under this authority, permits

TABLE III-13
SUMMARY OF EXISTING INFORMATION ON
UMB ARCHITECTURAL/HISTORICAL RESOURCES

RATING TYPE	AUTOMATIC LPAB REVIEW [a]	NO. OF UMBs	CUMULATIVE TOTAL OF UMBs SUBJECT TO AUTOMATIC LPAB REVIEW [b]
City Landmark	yes	42	42
Historic District "C"	yes	84	105
Historic District "CA"	yes	20	125
Historic District "NC"	yes	4	129
Area plans Significant	yes	25	150
Area plans Contributory	yes	38	188
C-3 Category I and II	yes	63	248
C-3 Category III, IV, V in CD	yes	165	409
1976 Citywide Architectural Survey	yes	571	786
NRHP listed or declared eligible	yes	85	793
NRHP nominated	no	284	793
Proposed Buena Vista North District	no	4	793
Proposed Chinatown District	no	255	793
Proposed Civic Center District	no	3	793
Area plans not significant	no	215	793
C-3 Category V not in CD	no	205	793
Heritage rated	no	1451	793
No information	no	322	793

Source: San Francisco Department of City Planning

(a) Rating types subject to automatic LPAB review of demolition or alteration permits on the basis of existing ordinance and policies. Permits for any building is subject to LPAB review on a disretionary basis under Proposition M authority.

(b) How to read this column: For each rating type, this column counts only those UMBs that are not already counted in the rating types above, i.e. overlapping protection categories are eliminated. For example, the second rating type--Historic District "C"--is a rating that applies to 84 UMBs. Of these 84, 21 are also City Landmarks. Consequently, 63 additional UMBs (84-21=63) are included in the cumulative total of UMBs that would be subject to review by the LPAB, yielding a total of 105 (63 + 42 =105).

affecting buildings that are unrated or proposed to be rated could come under LPAB review.

Finally, there are 322 UMBs for which information on the extent and quality of architectural/historic resources is not currently known. The ongoing DCP UMB architectural survey may reveal more buildings of merit and could ultimately lead to additional protection for them.

NOTES - ENVIRONMENTAL SETTING

1. Recht Hausrath & Associates, "Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings: Socioeconomic and Land Use Implications of Alternative Requirements," 1990. For San Francisco Department of City Planning.

2. The Working Group on California Earthquake Probabilities, "Probabilities of Large Earthquakes Occurring in California on the San Andreas Fault," 1988. United States Geological Survey Open File Report 88-398 and Press Release of July 19, 1990--report forthcoming. Menlo Park, CA.

3. Rutherford & Chekene, "Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings," 1990. For San Francisco Department of City Planning.

4. Charles Scawthorn, Dames & Moore, <u>Fire Following Earthquake</u>, 1987. Prepared for the All-Industry Research Advisory Council.

5. Office of Emergency Services, <u>Emergency Operations Plan</u>, <u>Volume I</u>, 1989.

6. Andrew S. Lawson, et al., <u>The California Earthquake of April 18, 1906: Report of the State Earthquake Investigation Commission</u>, 2v and atlas, Carnegie Institution, Washington, D.C., 1908.

7. John A. Blume, <u>San Francisco Seismic Safety Investigation, Geologic Evaluation</u>, URS Associates, 1974.

8. A.W. Garcia and James R. Houston, "Tsunami Predictions for Monterey and San Francisco Bays and Puget Sound," Type 16 Flood Insurance Study, report prepared for the Federal Insurance Administration, U.S. Department of Housing and Urban Development, 1975.

9. J.R. Ritter and W.R. Dupre, "Map showing potential inundation by tsunami in the San Francisco Bay Region, California," U.S. Geological Survey Miscellaneous Field Studies Map MF-480, 1972.

10. Relevant environmental documents, as follows:

Case No.	Title	Type	Date
81.3	Downtown Plan	EIR	Certified: 10/18/84
82.39	Rincon Hill Plan	EIR	Certified: 7/18/85
84.431	North of Market Special Residential District	Neg. Dec.	Approved: 2/21/85
85.463	South of Market Plan	EIR	Certified 12/7/89
86.505	Mission Bay	EIR	Draft 8/12/88
86.705	Chinatown Plan and Rezoning	Neg. Dec.	Approved: 2/11/87
87.586	Van Ness Avenue Plan and Rezoning	EIR	Certified 12/17/87

IV. ENVIRONMENTAL IMPACTS

A. INTRODUCTION

1. ORGANIZATION OF IMPACTS DISCUSSION

In the following pages, prior to the discussion of environmental impacts, this EIR will (a) outline the approach taken and assumptions made in carrying out its analysis of environmental effects of UMB Program Alternatives; (b) discuss the environmental review context; and (c) note the specific issues not addressed herein. Following that background information are discussions of (d) the types of construction activities (and associated impacts) needed to seismically strengthen UMBs; (e) the extent of estimated program-induced development (demolitions and conversions of use) and other changes to buildings; (f) growth-inducing impacts; (g) expected residential, employment, and institutional displacement due to construction activities; (h) expected residential and employment displacement due to program-induced development; (i) impacts related to geology/earthquake hazards, including expected human and building losses due to earthquakes under each alternative; and (j) impacts on architectural and historic resources.

2. APPROACH

The alternatives being considered for reducing the earthquake hazard were developed in recognition of the Bay Area's increasing high risk exposure to damaging earthquakes and the scientific expectation of disproportionate life loss and disability due to the structural failure of buildings with bearing walls constructed of unreinforced masonry. Three of the five alternatives would involve amending the San Francisco Building Code to require that UMBs be structurally strengthened to reduce the potential for occupant and pedestrian life loss and serious injury in damaging earthquakes.

The alternatives are programs to be carried out over a period of time

ranging from five to 30 years. Because of the general nature of the programs, uncertainties pertaining to future conditions, and imperfect information about the ± 2000 UMBs individually and collectively, it must be recognized that there are limitations on the specificity and accuracy of this environmental assessment of UMB program impacts. All discussions of program effects necessarily rest upon a series of assumptions. Critical assumptions are described, where appropriate, in this document. Many are outlined in the "Assumptions" subsection following. More detailed assumptions are described in the two primary background documents, the engineering /1/ and socioeconomic and land use /2/ reports, and the background files for this EIR, all available for review at the Office of Environmental Review. While the specific numbers in this EIR often have a wide range of uncertainty, reflecting the limitations described above, it is believed that the general relationships among alternatives as quantified or described in text are reasonably accurate.

Any program to seismically strengthen existing buildings would have both direct and indirect impacts. Direct impacts would result from the construction activities required to strengthen UMBS. Depending mostly on the extent of needed construction, short term displacement of residents or businesses may be required, and, in some cases, temporary displacement may lead to permanent displacement. These types of impacts are described below, accompanied by quantitative estimates of displacement effects. Construction effects on architectural resources are also assessed.

Another direct effect of adoption of any one or a combination of the alternatives is the change in expected deaths, injuries, and building damage due to earthquakes. This information is crucial in assessing the ability of an alternative to meet the program objective of hazard reduction. The information is presented in the Geology/Earthquake Hazards section of this chapter. For each alternative, expected reductions in earthquake casualties and damage are presented and compared.

During meetings held to determine the scope of this EIR issues were repeatedly raised concerning various indirect effects. Indirect effects are

those effects other than direct construction impacts which can be ascribed to adoption of an alternative. It must be recognized that none of the alternatives proposes a specific development. However, in response to a City requirement that UMBs be strengthened, it is possible that due to the costs involved and other considerations, some building owners would prefer to redevelop their properties in one of several ways that could generate impacts. Many indirect effects may be associated with owner decisions when faced with a mandate to strengthen a building. For example, owners may elect to demolish their UMBs instead of strengthening them. A number of "building outcomes" can be expected with or without a UMB program. These outcomes are described and quantified for each alternative in Section IV.C. Impacts can be caused due to the expected program-induced building outcomes. For example, cumulative building owner decisions to convert or demolish residential UMBs due to the cost of mandatory retrofit would lead to a reduction in the existing supply of housing. Progam-induced new construction following demolition, or conversion of UMBs to more intensive uses, constitute growth-inducing impacts, discussed in Section IV.D.

3. ASSUMPTIONS

This subsection will outline some of the more critical assumptions necessary to carry out and quantify environmental analysis contained in this document.

Five program alternatives were selected for analysis by the Chief Administrative Officer's UMB Task Force. These alternatives are intended to bracket the extent of impacts which could be generated by any finally adopted alternative or combination of alternatives. It is usually not possible, nor was it attempted in this case, to describe precisely the specific program which might ultimately be adopted. Indeed, early in the program decision-making and environmental review process the decision was made that this EIR would examine the full range of alternatives in as much detail as possible in advance of promulgating a preferred alternative. It was assumed that some kinds of impacts (e.g. deaths due to earthquakes) would reach their

extreme under the minimum action the City could do, Alternative A (no project), and that other kinds of impacts (e.g. program-induced demolitions) would reach their extreme under the highest strengthening level the UMB Task Force would consider, Alternative E.

To describe each of the five alternatives and their effects in as much detail as possible did not mean, in this case, that each alternative could be described in equal detail. Alternative A, no further action nor adoption of any particular new program, was analyzed based on the assumption that recent trends of owner decisions to strengthen UMBs would continue in the future. Alternative B, in particular, was only sketchily defined as some kind of voluntary retrofit program. It was assumed that any retrofit performed under Alternative A or B would be to a 104(f) (Alternative E) level. To examine the impacts of Alternative B, the assumption was made that, because of its voluntary compliance nature and relatively high level of strengthening, and because the City's options for providing incentives to retrofit are limited, few owners would voluntarily strengthen their buildings. Therefore, while it can be seen with certainty that the overall effects of Alternative B would fall between those of Alternative A (no new program at all, with relatively few UMBs strengthened even over the maximum 30 year time period studied) and Alternative E (every UMB mandated to a relatively high level of strengthening), the assumption led to the reasonable assessment that the overall effects would fall much nearer to those of Alternative A. For those particular buildings which would be strengthened under Alternatives A or B, effects would be similar to those of particular buildings strengthened under Alternative E.

It should be understood that the analysis of alternatives in this EIR is intended to provide a framework for understanding relative impacts among them as well as to bracket the possible range of impacts. The City may decide that some combination of alternatives is appropriate, for example, Alternative B for small residential buildings, Alternative D for other residential buildings, and Alternative E for all non-residential buildings. The general effects of such a combination of programs would be discernible based on

interpolation of the effects given for the discrete alternatives in this document.

The following additional important assumptions have been made:

- All 1990 regulations were assumed to be in effect over the analysis timeframe.

- 1990 building uses and rent levels were assumed to continue over the analysis timeframe to estimate the degree of building owner burden retrofit costs would entail. In reality, these factors would fluctuate in the future. Forecasts of building outcomes incorporate expected future conditions and trends for real estate market and development patterns in San Francisco.

- While it is probable that many building owners will choose to remodel their buildings when retrofitting (since the opportunity for installing new building systems and finish work efficiently presents itself while the building is undergoing retrofit construction work), insufficient information about individual UMBs is known to enable quantification of this possible program outcome. Remodelling and upgrading of building space is discussed qualitatively in the RHA 1990 report. /2/

- Displacement due to construction depends on whether or not and to what extent (totally or partially) the building is vacated, which in turn depends on both the amount of disruption the construction work would cause to occupants and the relative cost savings of doing work on vacated buildings versus loss of rental revenue and rerenting costs. While it could be argued that the alternatives could be most directly compared by holding all assumptions constant among them, this would in fact lead to distortions. Neither the assumption that all buildings would be retrofit vacant nor that all would be retrofit with occupants in place was considered

realistic. It was therefore assumed that the three alternative mandatory levels of strengthening would involve different patterns of occupancy and vacancy depending on the disruption and cost factors mentioned above. The detailed assumptions are presented in Table IV-4 and accompanying text.

- Based on current information, it is considered likely that most UMB retrofit work would trigger State-mandated requirements for disabled access. Such work could vary widely, with concomitant cost variation from building to building, depending on details of existing building layouts which are not known at this time. Therefore, disabled access requirements and associated costs were not taken into account in the underlying cost estimate analysis and data prepared as background to the EIR analysis. Similarly, possible construction costs due to various non-seismic Code requirements undertaken simultaneously with retrofit work have not been included in the assessment.

4. ENVIRONMENTAL REVIEW CONTEXT

This EIR is not intended to be a program EIR in that it does not attempt to cover all of the indirect effects which could occur as a result of adoption of a UMB program, such as possible future redevelopment of specific UMBs or UMB sites. Rather, it provides a general and comparative assessment of the reasonably foreseeable environmental effects of each of the five alternatives. Subsequent applicable owner decisions related to specific sites would still be subject to CEQA review. Retrofit of individual buildings is generally exempt from environmental review. Demolition of UMBs and building of larger replacement structures would normally be subject to CEQA assuming certain size thresholds are met. When environmental assessment is warranted based on the detailed circumstances of a proposal, it would be based on project- and location-specific information about changes in density, traffic patterns and other relevant details.

On a more general and cumulative impact level, many development-generated impacts that may be associated with the alternatives have already been assessed, because many owner decision patterns are likely to follow on-going trends in land use that were foreseen and analyzed in other environmental documents prepared in conjunction with several recent City actions. These include EIRS or Negative Declarations prepared for various amendments to the Master Plan and/or City Planning Code, including the Residence Element and relevant plans for areas where the UMBs are concentrated, covering Downtown, Chinatown, North of Market, Rincon Hill, South of Market and Van Ness Avenue. In addition, the recent environmental review of the Mission Bay development proposal updated and analyzed ongoing development trends for some of the plan areas mentioned above (Downtown, North of Market and South of Market) as well as for the additional UMB concentration areas of Inner Mission, Showplace Square and greater Potrero Hill. These environmental documents are available, by appointment, for review at the Department of City Planning, 450 McAllister Street, 6th Floor (558-6396). See Note 3 for a complete listing.

5. ISSUES NOT ADDRESSED

The alternatives under consideration were examined in an Initial Study (included in this EIR as Appendix D) to identify potential effects on the environment. Some impacts associated with one or more of the alternatives were determined to be potentially significant and are discussed in this EIR. These environmental topics are: land use; housing and population distribution; employment displacement; geologic hazards; architectural/ historic resources; established education and religious uses; health hazards; transportation; and urban design resources. Several potential environmental impacts were determined to be either insignificant, or mitigated through measures incorporated into the project. These will not be addressed in the EIR: air quality and climate; utilities and public services; biology; noise; energy; hazardous and toxic wastes; and buried remains of prehistoric or historic resources.

Social and economic issues, such as the cost burdens of strengthening; housing affordability in light of potential rent passthroughs for strengthening costs; and affordability of commercial space, especially for the small businesses that tend to occupy the UMBs, will clearly be important factors in decision making for both individual owners, the Board of Supervisors, and any others that may become involved. These and other social and economic considerations and impacts are discussed in a companion document, Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings: Socioeconomic and Land Use Implications of Alternative Requirements, prepared for the Department of City Planning by Recht Hausrath & Associates (RHA 1990). As will be referenced throughout the EIR, findings of the RHA study were used as one basis for estimating the occurence or intensity of certain environmental impacts.

B. PROGRAM-INDUCED CONSTRUCTION ACTIVITIES AND IMPACTS

1. INTRODUCTION

The selection of particular construction activities to carry out retrofit will vary based on both the alternative and the characteristics of individual buildings. These design decisions can only be made by qualified professionals on a building-by-building basis at such time as building strengthening may be undertaken. Analysis of individual UMBs was well beyond the scope of this assessment and associated studies. However, in order to enhance the accuracy and precision of the assessment, Rutherford & Chekene developed 15 building prototypes (shown in Figure IV-1) for use in the engineering analysis, including their retrofit cost and damage estimates. The 2007 UMBs studied were sorted into 15 prototypes based on plate size (size of ground floor), height, configuration, and use. These four basic variables account for much of the variation in both cost of engineering strengthening solutions and failure modes of these buildings when subjected to shaking. Table IV-1 describes the prototypes and the number of UMBs in each.

In order to assess the short term, temporary effects of construction

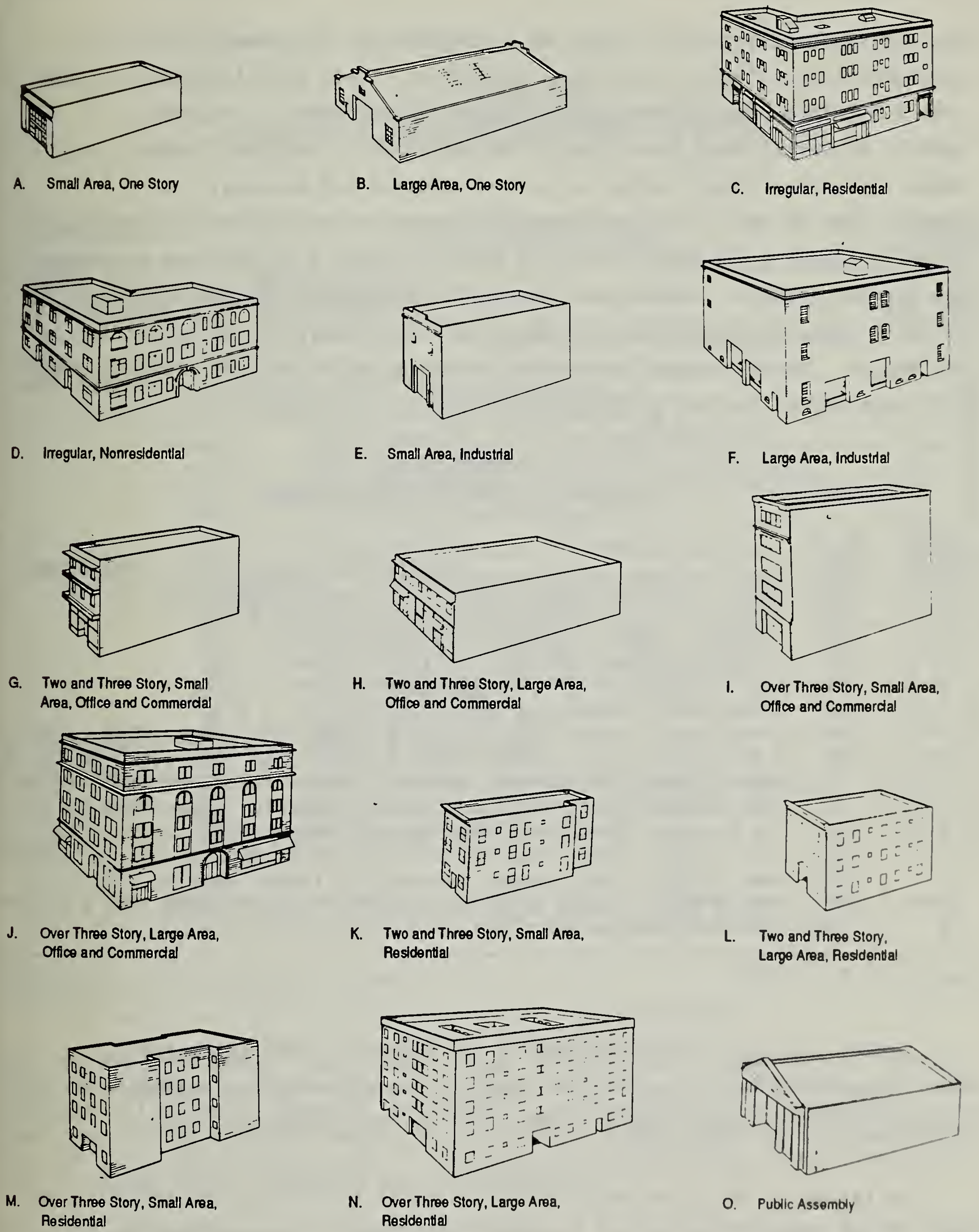


Figure IV - 1 UMB Prototypes

activities for alternative levels of strengthening, 22 commonly utilized strengthening activities have been identified. These activities are derived from R & C 1990 (pp 3-37 through 3-69) and are described in Appendix D. {NOTE: Reviewers having an interest in the specific technical aspects of these activities should refer to the descriptions and drawings in R & C 1990.} Some of these activities would be common to all of the alternative retrofit levels while others would be used to comply with only one or two of the retrofit levels. Actual work needed for a building to comply with a retrofit code requirement would combine several activities, as called for by the design. In some cases, use of one activity would preclude use of another, i.e. some activities are mutually exclusive.

TABLE IV-1
PROTOTYPES FOR ANALYSIS OF UMBs

Prototype	No. of UMBs	Description
A	136	Small Area, One-Story (under 4000 sq. ft. plate size (p.s.))
B	169	Large Area, One-Story (over 4000 sq. ft. p.s.)
C	138	Irregular Shape, Residential (various p.s.)
D	97	Irregular Shape, Non-Residential (various p.s.)
E	89	Small Area, Industrial (under 5000 sq. ft. p.s.)
F	143	Large Area, Industrial (over 5000 sq. ft. p.s.)
G	236	2 & 3 Story, Small Area, Office & Commercial (Under 4000 sq.ft. p.s.
H	176	2 & 3 Story, Large Area, Office & Commercial (Over 4000 sq.ft. p.s.)
I	70	Over 3 Story, Small Area, Office & Commercial (Under 4000 sq.ft. p.s
J	83	Over 3 Story, Large Area, Office & Commercial (Over 4000 sq.ft. p.s.
K	162	2 & 3 Story, Small Area, Residential (Under 2500 sq. ft. p.s.)
L	147	2 & 3 Story, Large Area, Residential (Over 2500 sq. ft. p.s.)
M	139	Over 3 Story, Small Area, Residential (Under 4000 sq. ft. p.s.)
N	162	Over 3 Story, Large Area, Residential (Over 4000 sq. ft. p.s.)
O	60	Public Assembly-type (various p.s.)

Source: R & C 1990

Table IV-2 shows the percentage of San Francisco UMBs estimated to require application of a particular construction activity, depending on which alternative is selected (based on R&C 1990, pp. 3-73 through 3-105).

Variation in the duration of construction is basically a function of the cost of the work and the extent to which a building is occupied during

TABLE IV-2
PERCENTAGE OF UMBs THAT WOULD REQUIRE
A PARTICULAR CONSTRUCTION ACTIVITY, BY ALTERNATIVE

STRENGTHENED AREA	#		ACTIVITY DESCRIPTION	ALTERNATIVE C	D	E
ANCHOR WALLS TO DIAPHRAGMS	1		Tension Anchors	91	91	91
	2		Shear Anchors	100	100	100
OUT-OF-PLANE WALL BRACING	3	(a)	Interfloor Wall Supports (Visually Exposed)	42	38	42
	4	(a)	Interfloor Wall Supports (Visually Hidden)	41	41	41
	5		Supplemental Vertical Supports	0	35	0
	6		Anchor Non-Parapet Falling Hazards	18	18	18
DIAPHRAGMS	7	(a)	Roof Sheathing with New Roof (Outside)	0	43	76
	8	(a)	Roof Sheathing Inside (Soffit or Ceiling)	0	4	9
	9	(a)	Roof Crossbracing or Other Special Solution	0	4	9
	10	(a)	Floor Sheathing - Open Area	0	7	30
	11	(a)	Floor Sheathing - Existing Partitions	0	13	34
	12		Chords	0	0	100
	13		Collectors	0	34	100
	14		Strengthen Existing Crosswalls	0	34	0
	15	(b)	Add Crosswalls	0	19	0
	16	(b)	Steel Moment Frame (as a Crosswall)	0	11	0
IN-PLANE STRENGTHENING	17	(b)	Infill Openings	0	3	6
	18	(b)	Concrete Against Wall	0	8	15
	19	(b)	Steel Diagonal Brace	0	16	41
	20	(b)	Steel Moment Frame (as a Lateral Element)	0	7	15
	21	(b)	Interior Freestanding Masonry Shear Wall	0	7	17
	22	(b)	Interior Plywood Shear Wall	0	4	0

Source: R & C 1990.

Note: Percentages are approximate. Retrofits under Alternatives A and B would utilize construction activities most similar to Alternative E.

(a) mutually exclusive activities
(b) alternative activities, but could be used in combination

How to read this table: For example, under Alternative C, about 91% of the San Francisco UMBs would require tension anchors (Activity 1), and none would require supplemental vertical supports (Activity 5), to comply with the Alternative C code requirement. As another example, steel diagonal braces would not be required for any buildings under Alternative C, for about 16% of buildings under Alternative D, and for about 41% of buildings under Alternative E.

Detailed engineering descriptions and drawing of typical details are found in R & C 1990, pages 3-37 through 3-69.

retrofit work. The work process would be less efficient, would take longer, and be more costly with occupation of the building. The estimated typical durations for seismic strengthening construction work are given in Table IV-3 by prototype for each alternative. Construction duration is given for vacated buildings versus those in which maximum reasonable occupancy would be maintained. The increases in time for occupied buildings vary by both use group and alternative as indicated at the bottom of Table IV-3. Generally, these time premiums range from 25 to 100% depending on density of occupation, building size (generally, the smaller the building, the more difficult to perform the work with occupants in place) and type of building use. Duration also varies by alternative strengthening level, with C generally requiring less time than D and level E requiring the longest time, with some buildings taking as long as a year to complete. Total construction time for any one building would vary widely from the averages given.

2. PROGRAM-INDUCED CONSTRUCTION IMPACTS

a. Introduction.

This section describes the short-term, temporary impacts associated with construction or strengthening work that would occur on-site. Residential, commercial, and institutional displacement, and impacts on architectural resources due to construction, are described later in this Impacts Section. It is important to note that this assessment assumes that maximum reasonable occupancy would be maintained during construction, whether the building use is primarily industrial, commercial or residential. The question of whether to retrofit with occupants in place will depend on the amount of additional cost, disruption, relocation options, and other considerations for a building owner. In general, it costs less to retrofit a vacant building, but lost revenue and rerenting (and possibly relocation) costs must be taken into account. From discussions with experienced professionals and the limited literature /4/ /5/, it is reasonable to assume that most owners own the building for rent production and will need or want to have a continuous income

TABLE IV-3
AVERAGE CONSTRUCTION DURATION (IN WEEKS) BY PROTOTYPE AND ALTERNATIVE (FOR VACANT AND OCCUPIED BUILDINGS)

	ALTERNATIVE					
	C		D		E	
Prototype/Description[a]	Vac.[b]	Occ.	Vac.	Occ.	Vac.	Occ.
A - small, 1 story	4	5	4	7	4	7
B - large, 1 story	5	6	6	9	8	12
C - irreg., Resid.	6-18	9-28	10-30	18-58	16-32	30-60
D - irreg., Non-Resid.	6-18	8-25	10-30	17-51	16-32	27-54
E - small, Indust.	6	7	6	8	8	10
F - large, Indust.	7	8	10	12	12	15
G - sm., 2-3 story, Off/Comm.	6	8	6	10	8	14
H - lg., 2-3 story, Off/Comm.	7	10	9	15	12	20
I - sm., 4+ story, Off/Comm.	6	8	9	15	12	20
J - lg., 4+ story, Off/Comm.	10	14	16	28	28	48
K - sm., 2-3 story, Resid.	5	9	6	12	7	14
L - lg., 2-3 story, Resid.	6	10	7	14	8	16
M - sm., 4+ story, Resid.	6	10	11	22	12	24
N - lg., 4+ story, Resid.	9	15	18	36	30	60
O - Public assembly	9	13	11	19	16	28

Source: Based on R & C 1990

(a) Refer to the EIR's inner back cover for more prototype description details

(b) Vac. = vacant during construction
Occ. = reasonable occupancy during construction

Time premiums to accommodate occupancy while retrofit work takes place are estimated as follows:

	Alternative C	Alternative D	Alternative E
Industrial Group	25%	25 - 50%	25 - 50%
Commercial Group	40%	70 - 100%	70 - 100%
Residential Group	50 - 60%	100%	100%

stream from tenants while the work is being performed. Some owners occupy their own buildings and would tend to remain open for business and want to avoid paying rent elsewhere. Consequently there would be a tendency to maximize building occupancy during construction work.

At the same time, in some UMBs some of the work needed for Alternatives D and E can cause major disruption, to the point where habitability can be called into question, even if the work is technically feasible at greater cost. Rodent and pest infestation and open roofs pose the biggest concern. In some cases in Los Angeles, roofs were removed for as long as 4 weeks. Utilities are disrupted and ceilings are exposed. Dust can accumulate, fire exits may be blocked, and the cumulative effects of noise interruptions and worker access needs mount up over the months to create a substantial disruption to building inhabitants. In consideration of this level of disruption, some types of buildings are assumed to be entirely vacated during construction to comply with Alternatives D and E (Table IV-4). Since construction activities for Alternatives A and B would be voluntarily undertaken by owners to the level of Alternative E, it is assumed that all such UMBs would be vacant. These latter types of projects are assumed to occur in commercial buildings in which substantial long-term returns for major remodelling of building systems and a change in type of tenancy are expected. Buildings generally would not need to be vacated due to construction necessary to comply with Alternative C, as Table IV-4 also indicates.

With rare exceptions, the impacts associated with strengthening will occur on-site, primarily inside the UMBs, and would mainly be limited to noise, dust and, in some cases, substantial inconvenience and disruption to building occupants. Following is a detailed assessment of expected short-term construction impacts, by alternative.

b. Alternative A: No Project.

This alternative would not result in either a requirement for, or a program to encourage, UMB strengthening. Consequently, any UMB upgrade

TABLE IV-4
ASSUMED STATUS OF BUILDING OCCUPATION[(a)]
DURING CONSTRUCTION BY PROTOTYPE AND ALTERNATIVE
FOR IMPACT ANALYSIS PURPOSES

	ALTERNATIVE		
Prototype/Description[(b)]	C	D	E
A - small, 1 story	occupied	vacant	vacant
B - large, 1 story	occupied	occupied	occupied
C - irreg., Resid.	occupied	occupied	occupied
D - irreg., Non-Resid	occupied	occupied	occupied
E - small, Indust.	occupied	vacant	vacant
F - large, Indust.	occupied	occupied	occupied
G - sm., 2-3 story, Off/Comm	occupied	vacant	vacant
H - lg., 2-3 story, Off/Comm	occupied	occupied	occupied
I - sm., 4+ story, Off/Comm	occupied	occupied	vacant
J - lg., 4+ story, Off/Comm	occupied	occupied	occupied
K - sm., 2-3 story, Resid	occupied	vacant	vacant
L - lg., 2-3 story, Resid	occupied	occupied	vacant
M - sm., 4+ story, Resid	occupied	occupied	vacant
N - lg., 4+ story, Resid	occupied	occupied	occupied
O - assembly	occupied	occupied	occupied

Source: San Francisco Department of City Planning

Key: Vacant = totally vacant;
Occupied = mostly occupied, i.e. higher than normal vacancy with staged construction and possible, short-term tenant moves within the building.

(a) Assumptions for Table IV-4: The assumptions regarding occupancy during seismic strengthening construction are based on consideration of (a) physical disruption expected and the likelihood occupation could continue, and (b) economic incentives for owners when time and cost savings for construction in vacated buildings are compared with lost revenues. Building prototypes which have been assumed to be vacated are characterized by constant, serious disruption to occupants during retrofit work as well as high ratios of occupancy cost premiums to lost revenues due to vacancy. Not all buildings in prototypes assumed for vacancy would in fact be vacated, nor would all buildings in prototypes assumed for occupancy be occupied during retrofit. The assumptions are intended to provide a more realistic assessment of impacts than a more simplistic assumption of all buildings occupied or all buildings vacated.

(b) Refer to the EIR's inner back cover for more prototype description details.

performed would be at owner initiative to the level prescribed by SFBC, Section 104(f) (the same level of strengthening that would be required for Alternative E). Over the last several years only two to three UMB owners per year have taken this action. To date, it has been almost always associated with a commercial building for which a change of use or intensity of use is proposed. Most often, this seismic strengthening work is associated with a major remodel of an empty building. Assuming that this small number of annual upgrades continues in essentially empty building spaces, no construction impacts of any potential significance would result from Alternative A.

c. Alternative B: Voluntary Program.

As was previously described (Chapter II, Section D), several local jurisdictions have adopted ordinances intended to reduce the UMB-associated earthquake hazard but that do not require strengthening of buildings. These ordinances provide a code prescription that is less than would be required for new construction and some also require that engineering designs be developed accordingly and be made part of the public record to be disclosed in any real estate transaction. In a few cases, incentives are a part of these programs. For example, Palo Alto exempts additions of up to 2500 square feet (sq. ft.) or up to 25% of existing floor area from parking requirements for the buildings covered by its program. Of the eight locales that have adopted voluntary programs only the Palo Alto ordinance, adopted in 1986, has implementation experience. The other programs were adopted after the October 17, 1989 earthquake.

Palo Alto's program applies not only to UMBs but also to other building types known to pose life-safety hazards in damaging earthquakes. Of the 100 buildings covered by the ordinance, 52 are UMBs and six of these are exempted based on their small size (and occupancy potential) of less than 1900 sq. ft. Of the remaining 46 UMBs, 14 have been strengthened, three have been demolished and replaced with new buildings that are sized to capitalize on the ordinance's parking exemption, 21 engineering reports have been accepted, and eight reports are overdue (as of October 1990). /6/

The Palo Alto UMBs subject to compliance with the ordinance are essentially downtown commercial buildings where investments in general upgrades, including seismic strengthening, can often be justified by expected long-term monetary returns. Such upgrades are rarely performed on residential buildings and are expected to be infrequent with Alternative B. Consequently, overall environmental effects of a voluntary program (Alternative B) are expected to be somewhat greater than Alternative A but less than for Alternatives C, D or E. Individual UMBs would be subject to the construction activities discussed in Alternative E.

d. Alternative C: Anchorage and Interconnection.

(1) Construction Activities. {Note: The construction activity numbers used in the following paragraphs relate to those given by name and percent use in Table IV-2. Much more technical detail on these activities, including sketches, are given in R & C 1990}. Construction activities required by this alternative are limited to those which anchor unreinforced masonry (URM) walls to floors and roofs (Activities 1 and 2), or those which are intended to prevent walls from collapsing perpendicular to their length, or "out-of-plane" (Activities 3 or 4, and 6). Typically this work would be confined to the perimeter of the building at the locations of exterior URM walls. However, larger buildings may have interior walls of URM that must be treated similarly. Although some wall anchors may exist from the original construction of the building or subsequent remodels, virtually all UMBs would require supplementary wall anchorage work. On the other hand, only certain walls that fall outside the limits of acceptable height-to-thickness ratios would require out-of-plane bracing between floors.

(2) Characteristics of Construction. Retrofit projects using Alternative C would generally be considered small, rarely exceeding $175,000 in construction costs. A small area within the building, preferably at the ground floor, would normally be provided to the contractor for an office, staging, and storage location. The number of workers required by any one operation would be two to three. Depending on the size and shape of the building and the

project schedule, a contractor may choose to have several such crews working at once. Materials used would include bolts and hardware for anchors (Activities 1 and 2) and, when required, steel or wood studs for out-of-plane strengthening (Activity 3 or 4). Plywood and gypsum wall board might also be required depending on the exact detail of wall anchorage and finishes to be matched.

In order to install wall anchors, the floor-wall intersection must be exposed. In almost all cases, this can be accomplished from either the floor down or the ceiling up. Building contents that are adjacent to URM walls typically must be moved, particularly when out-of-plane bracing is required. This could include manufacturing equipment, storage racks or shelving, built-in office or residential cabinets, furniture, appliances, or piping and conduit. If out-of-plane bracing is needed, finishes must be removed from the URM walls in preparation for installation of studs. In some cases where an elaborate or historical finish is present on both sides of a wall, the process of centercore drilling may be appropriate (Activity 4). If the building is vacant, finish removal would probably be done continuously through the building, in one operation. Preparation for installation of bolts, hardware and studs would be done concurrently because their connection details at each floor are interrelated.

Following removal of necessary finishes, it may be necessary to reroute piping or electrical lines that interfere with the seismic strengthening elements. This work can be preplanned during design, but often unexpected lines are discovered beneath finishes. It is best to design strengthening elements to cause no such costly and disruptive interference, but occasionally it is unavoidable.

Connections to the URM walls are made by drilling holes into or through the wall. Rotary (drilling) equipment is used, rather than impact type equipment, to minimize vibrations in the unreinforced masonry. If work is done from the ceiling upward, small scaffolding may be required. Drilling is noisy and creates fine dust which is difficult to contain within construction

areas. Bolts with plate washers or bolts grouted in place complete the connection to the URM wall. Necessary hardware is installed, the strip of floor or ceiling is replaced, and new finishes are added to match the surrounding area.

The work required by Alternative C is not too different from a normal remodel which is often accomplished with occupants in the building. Occasional disruption from construction worker traffic would occur and the presence of fine dust from URM drilling and placement of plaster or gypsum wall board would be expected for several months after the work is complete. This general level of disruption to occupants would be exceeded if welding of structural steel is required within the building. Ventilation must then be provided and heavier equipment than generally associated with remodeling would be used. Such work can normally be avoided with careful design, but would occasionally be required.

Old finishes, particularly wall finishes such as wallpaper, faded paint, wood wainscoting, and other elaborate trim, are often hard to match, so the entire wall surface would likely require work to achieve a high quality finish. Floor finishes can cause similar match-up difficulties. This natural extension of minimum finish work will tend to enlarge seismic strengthening work into partial remodels. If low quality finishes are acceptable (as in some basements or industrial buildings), mismatches could be left and finish work minimized.

(3) Variations by Prototype Group. The industrial group of buildings has the highest story height, on average, and therefore would require the most out-of-plane bracing. The installation of such braces will often interfere with piping and electrical utilities running against the wall. Heavy machinery or storage racks may also require temporary dislocation unless special design can avoid the interference. On the other hand, these buildings generally have a low level of finish and access to anchorage locations is good. The combination of low finish level, low density occupancy, and a probable high tolerance to construction noise should allow retrofit

construction to occur with full occupancy in most cases. Particularly disruptive work could also be scheduled at night or on weekends in some industrial buildings.

Commercial buildings would occasionally require out-of-plane wall bracing. Removal and replacement of finishes would typically be required and built-in cabinetry may also interfere with access to the floor-wall intersection. Because the work under this alternative is localized at the URM walls, areas could be temporarily vacated for 5 to 10 days to allow construction during occupancy. As with the industrial group, particularly disruptive work or work in sensitive areas could be done at night or on weekends. It would be most efficient if a small portion of the building could be vacated during construction to create a staging area for the contractor.

Because residential buildings generally have more partitions than other buildings, gaining access to the wall-floor intersections would affect more partitions and finishes than those of other groups. On the other hand, the small room size also affords natural opportunities to block off and seal construction areas for short periods of time if work is done while the building is occupied. Noise and construction worker instrusions would make occupancy in adjacent rooms uncomfortable for the 5 to 10 days that the complete cycle of construction may take in each room. Owners of residential buildings which feature small one room facilities should consider alternate room accommodations for this short construction period. If plumbing or electrical distribution, kitchens or bathrooms are located against exterior walls, special design details may be required to preserve acceptable living conditions in the immediate area of construction. Temporary dislocation on a unit by unit basis will also occasionally be required for these reasons.

Occupied residential buildings also are more sensitive to interruption of utility mains than other occupancy types. Loss of power can cause inconvenience and food spoilage and even a short interruption of gas service would require relighting pilots. Contractors may be concerned about potential damage or theft disputes when working in an occupied residential building. In

some cases, they may want third party escorts to monitor their actions.

(4) Project Duration and Occupation. Average project durations by prototype are provided in Table IV-3, page IV-13. For straightforward projects, project duration is generally proportional to project cost. Projects which cost less than $25,000 would take about 5-6 weeks. Projects between $25,000-50,000 would take 5-14 weeks and those with costs between $50,000-100,000 would take 9-28 weeks. According to contractors familiar with retrofit work, the time premium for construction while the building is occupied is estimated to be 25% for the industrial group, 40% for the commercial group, and 50-60% for the residential group. The residential group could be further broken down into tourist hotels at 40% premium and permanent residential at 70%. As was indicated on Table IV-4, Alternative C work is assumed to be performed with occupants in place (although dislocation from certain spaces may be required for periods of up to 10 days), therefore the above estimated construction durations reflect these time premiums.

e. Alternative D: Proposed Uniform Code for Building Conservation (UCBC).

(1) Construction Activities. Under Alternative D, wall anchors (and, in some cases, out-of-plane strengthening) required by Alternative C would have to be supplemented by evaluation and possible strengthening of the other building elements including floors and roofs (Activities 7-13) and in-plane strengthening (Activities 17-22).

About half of the Alternative D buildings would require roof strengthening with about 20% needing strengthened floors. Floor and roof strengthening can be minimized by adding plywood to walls. Additional crosswalls can also be installed. This trade-off of activities would have cost and disruption effects that would be considered on a case-by-case basis.

In multi-story buildings, in-plane strengthening of exterior URM walls may be required for walls with window or door openings. All building faces with storefronts that have little or no solid wall would require some kind of

in-plane strengthening element at or near the storefront wall. This may be accomplished by adding a rigid or braced steel frame, a crosswall or a plywood or masonry wall (this will depend on the stress, number of stories and other factors). The need for in-plane elements in a retrofit project represents a substantial increase in construction activity when compared to Alternative C. However, the percentage of UMBs requiring in-plane strengthening is considerably lower than for Alternative E, and strengthening that would be needed would represent a lesser increase in construction activity than for Alternative E. Construction activities under Alternative D are somewhat beyond a "remodel", and there may be extensive removal of finishes, installation of plywood walls, new finishes and possibly installation of structural steel. In some cases, new masonry or concrete walls would be added, or gunite over existing walls may be required.

The material, types and number of in-plane strengthening elements that will be appropriate for any one building depends not only on the building shape and dimensions, but also on other project parameters such as aesthetics, building function, or the need for continuous occupancy. Owners of residential and commercial buildings will seldom accept infilled openings, but this technique can often be used on industrial group buildings. New freestanding interior crosswalls are usually disruptive to the functionality of industrial and commercial buildings, but they may be the most cost effective solution for some owners. Steel braced frames can be more readily located and are less disruptive and lighter than concrete, but they are difficult to conceal.

Steel frames (Activity 20) may be selected for some UMBs. They are much more laterally flexible than new walls and braced frames but they are also more expensive and require considerable welding during erection. This type of frame has been used extensively for the front, open facade of commercial buildings. It is also usable for architecturally sensitive spaces and it may be the only solution for buildings with large open spaces such as churches and other assembly buildings.

(2) Characteristics of Construction. The actual amount of retrofit work to comply with Alternative D will vary greatly from building to building. Costs for this alternative may vary from $25,000 to over a million dollars for large UMBs.

A work area would be needed for the contractor. Materials must be stored on the job. The storage of anchor bolts, wood blocking and anchor ties would fit in the typical construction storage box. Most large pieces such as structural steel would be installed as soon as delivered although some site fitup and welding is often necessary. Storage of finish materials, like drywall, requires more than the construction storage box, but can typically be accommodated in some unoccupied space. Delivery to the site would require large trucks and trailers and, for short periods, cranes would be needed for structural steel installation. Excavation for concrete grade beams generally results in soil that needs to be removed from the site.

Strengthening of crosswalls and installation of plywood in walls require removal of existing finish, attachment of anchors or additional nailing and the placing of plywood, drywall or plaster (or all three) on the wall. These activities generate dust, noise and debris. When structural steel is installed, heavy components must be lifted and welded or bolted in place. Holes are often cut in the roof and floors to permit columns to be "dropped in". Where moment frames are used there would have to be a concrete grade beam. This would require excavation across the width of the structure, or portion thereof, to a depth of three to five feet and a width of two feet or more.

(3) Variations by Prototype Group. With the exception of those industrial operations with clean-room, dust-free requirements, industrial buildings usually permit the greatest flexibility in design and construction sequencing. Installation of bolts, filling in openings and the installation of steel elements can usually be accommodated without undue disruption. The concept of construction work in off hours is common in some industrial plants. If the floors require strengthening, there would be disruption in

occupied spaces. However, the appropriate placing of elements on the lower floor can eliminate the need for the floor strengthening.

In commercial buildings, disruption to occupied spaces is less tolerable. The open or front wall is often ornate and open for display. It cannot be filled, so a steel frame is most often used to provide the needed resistance. This method permits the finished space to function the same as it did before strengthening. Removal of plaster and cutting, fitting and drilling of wood blocking would create dust and noise. If a steel frame and grade beam need to be installed, excavation would be required. Security for the open building is an additional concern. Some of the work could be done from either the roof or floor above or below. This may permit many areas to remain occupied with short interruptions.

Since they are often occupied day and night, residential buildings pose the most constraints to design and construction in terms of scheduling work. However, residential buildings tend to have more interior walls, which the Alternative D approach allows to be counted toward the level of existing resistance for purposes of strengthening calculations. Frequently, the walls at the upper floors require no work, although the walls of the top floor must be extended from the ceiling to the roof to act as cross or shear walls. At the lower levels, walls may require strengthening with the installation of plywood. The installation of anchor bolts results in dust, debris, disruption and noise. This may take several days, during which dirty, drafty spaces may be left in dwelling units or other work areas.

Because of the need for space within which large-sized materials can be stored, maneuvered and installed, many smaller UMBs are likely to be vacated entirely during the construction period. Based on the experience gained implementing the Los Angeles program it is estimated that approximately 30% (about 600) of the UMBs would be temporarily vacated during the 4 to 6 weeks it would take to complete construction activities, mostly in the smaller buildings.

Of course some smaller buildings may not be vacated and some of the larger buildings would be. Based on the L.A. experience where an estimated 90% of the buildings were worked on with at least some level of occupancy, the 70% occupied figure represents a reasonably conservative estimate for purposes of assessing displacement impacts.

(4) Project Duration. In vacated buildings, the smaller projects (less than $75,000 construction cost) would take about 6-8 weeks. Projects between $200,000 and $400,000 would take 10-14 weeks. Larger projects in the $750,000 range could be expected to utilize large crews, and would take 20-30 weeks in vacant UMBs. For Alternative D, the time premium for construction while the building is occupied (in which the work would likely be phased with occupants moving in and out of vacant space for short periods of time) is estimated to be 25-50% for the industrial group, 70-100% for the commercial group, and 100% for the residential group.

f. Alternative E: San Francisco Building Code, Section 104(f).

(1) Construction Activities. Retrofit projects generated by this alternative could require the full range of construction activities. Wall anchors and out-of-plane strengthening required by Alternative C will almost always be supplemented by strengthening of roofs and floors (Activities 7-13) and in-plane strengthening (Activities 17-22). The need for in-plane elements in a retrofit project represents a substantial escalation in construction activity, and a relatively high percentage of UMBs would need major elements such as steel cross-bracing to comply with Alternative E. Construction activities would be far more intensive than a "remodel". For those buildings that need to utilize structural steel or concrete, new foundations would be required. Foundation work is highly variable depending on the soils conditions and height of the building. In poor soils, the foundation can have a large effect on costs and construction activity. In many cases, soils and foundation considerations would dictate that the need for in-plane elements is greater than otherwise required.

(2) Characteristics of Construction. Except in the smallest buildings, retrofit projects under Alternative E would require extensive construction work. Construction costs will typically be in the hundreds of thousands of dollars and could be well over one million dollars for buildings with over 50,000 square feet of area. Typically, a 2,000 to 3,000 square foot construction staging area would be needed within the building. Large construction vehicles and equipment, which may include delivery trucks, concrete mix trucks, compressors and truck cranes, would occasionally need to be parked outside the building.

Materials that may be required would include all of those discussed for Alternative C plus structural steel and concrete. Finish work would be more extensive so considerable amounts of lumber, steel studs, plywood and gypsum board would need to be stored at the site or frequently delivered. Access to the upper floor would be important. If a freight elevator is not available, access through windows would have to be developed, necessitating use of truck mounted cranes or lifts, or temporary lifts attached to the outside of the building. If work, delivery and storage is not contained within the building, sidewalk protection tunnels may have to be erected. If the building is to be partially occupied during construction, separation of occupant and construction traffic would be desirable, including separate entrances, but such a separation is often impossible due to fire exit requirements for occupied spaces.

Installation of wall anchors and out-of-plane braces under Alternative E is the same as Alternatives C and D. It is the large extent of required floor and roof strengthening that primarily distinguishes this alternative from the others and the work involved can affect every area of the building. All floor finishes must be removed in the areas where plywood is required. Wood blocks would often have to be cut to exact size and placed between joists. Plywood would then be installed over the existing floor coverings and extensively nailed down. The area must then be refinished. Some finishes, like vinyl tile, will require that additional underlay material be placed over the plywood before installation. In addition, chord members along walls (Activity

12) are often required, which can affect all utilities that run vertically on the perimeter of the building. For example, rainwater gutter drains often have to be replaced or rerouted around the chord member. In irregularly-shaped buildings, collectors (Activity 13) may be needed, requiring additional areas of the floor to be opened up through the ceiling or floor. Floor and roof strengthening work is mostly carpentry, involving extensive sawing, hammering and nailing. Air powered nailing guns are efficient and relatively quiet, but not all nailing is done this way, so occupation of areas directly below this work would be quite disruptive. Access to the floor structure from below may also occasionally be required.

The heaviest construction work in seismic retrofitting of UMBs is placement of in-plane strengthening elements which would be required for at least three quarters of the buildings under this alternative. Foundations are almost always required, and this work involves excavation and removal of soil, and placement of reinforcing steel and concrete. If access to the location of the new foundation is not available directly from the outside, then soil must be removed and materials brought in through the building. In-plane elements must always penetrate the floors, which requires work on at least two levels at once. Temporary holes in the floors are needed and shoring of the floor structure is often required until the element is installed.

Structural steel diagonal bracing is made up of steel members which are often 20 feet long and over 500 pounds. Smaller members can sometimes be used but then more extensive field erection such as welding or bolting is required. In vacant buildings, the steel has sometimes been placed from above, through holes in roofs and floors cut expressly for this purpose. Bolts can be installed without noisy power tools, at a cost premium. Welding requires generators and fresh air venting of fumes. Welding around the wood floors typical of UMBs also requires special fire protection.

Installation of concrete, shotcrete, or concrete block are all "wet", messy processes. Water is required in all three either in preparation, placement, or cleanup and preventing the water from affecting wood floors is

difficult. Shotcrete, or gunite, is normally used against an existing URM wall. The face of the brick wall is cleaned and roughened, and steel dowels are placed in drilled holes. After reinforcing bars are placed, the shotcrete material is pumped through hoses and blown in place. Because of the high pressure involved, venting to the outside must be provided. Cleanup after shotcrete work is extensive as some material, called "rebound", does not adhere to the surface. The surfaces of concrete, block or shotcrete are seldom aesthetically acceptable, except in industrial buildings, and are therefore often plastered or otherwise covered over. The work of installing these kinds of in-plane elements is difficult to confine in small spaces.

Previous retrofits employing SFBC, Section 104(f) criteria have usually been performed on vacant buildings. Although experience and refinement of strengthening techniques may prove otherwise, it is currently projected that most projects using Alternative E will require large building areas dedicated to the contractor. Preferably, the building would be vacated, but phasing vertically, two floors at a time, or horizontally, when a building has wings or other natural separations, is considered feasible in most cases. Vertical phasing should be assumed to start at the bottom of the building and work up to prevent creating temporary decreases in seismic resistance during construction. The temporary seismic response of buildings using horizontal phasing must also be considered.

It is estimated that nearly half of the UMBs would be completely vacated for the work mandated by Alternative E. Expected vacancies would include all of the smaller building types listed in the Alternative D discussion plus taller, small plate sized office and commercial buildings, plus all but the largest residential UMBs.

(3) Variations by Prototype Group. Industrial buildings (except for the smaller ones) would afford the greatest options for strengthening without undue disruption of functions. Where manufacturing is involved, particular attention would have to be paid to machinery and utilities to maintain operations. Wall openings can often be infilled in these buildings to avoid

addition of in-plane elements. However, many of these buildings have large footprints that may dictate additions of interior freestanding in-plane elements. The most troublesome and disruptive construction activity associated with Alternative E, installing new plywood on floors (Activity 10 and 11), would be easiest in industrial buildings. The general lack of partitions and floor finishes eases installation, and a higher tolerance to disruption often would allow operations to proceed by simply working around the building function. Off-hour work is also more feasible in most industrial buildings.

The basic characteristics of buildings in the commercial group will affect their retrofit design and construction. Infilled openings would seldom be used to strengthen walls. Freestanding solid wall elements would probably be avoided in order to maintain maximum flexibility of use in office and commercial spaces. Steel frames may prove popular in smaller buildings so that openness can be maintained in retail spaces. Although noisy or disruptive work could be done on nights or weekends, the kinds of activities often required by Alternative E, particularly adding plywood on floors and adding in-plane elements, are incompatible with commercial or office operations and it is expected that temporary evacuation or construction phasing in partially emptied buildings would be employed.

Residential group buildings place the most limitations on retrofit project design for Alternative E. In-plane elements must be placed on pre-existing wall lines and may normally not block windows. Concrete placed against the URM walls and freestanding concrete block walls would be logical in-plane strengthening elements if the buildings are vacant. Use of these elements in an occupied building would dictate a phasing plan and would probably require closure of areas on more than two floors at once. Placing plywood on floors is difficult due to the many partitions, appliances, bath tubs, showers, and other elements that are somewhat fixed in place. Plywood may be placed on the ceiling to avoid those fixed elements, but partitions will still interfere, and all ceiling finishes would have to be replaced. Since these buildings essentially have continuous occupancy, construction

timing cannot avoid disruption impacts to remaining residents if the building is not fully vacated. In smaller buildings that have little area in which to create isolated construction phasing, retrofits may force temporary evacuation. In all but the largest residential UMBs, evacuation during construction is considered likely.

(4) Project Duration. For straightforward projects with vacant buildings project duration is generally proportional to project cost. Smaller projects less than $100,000 construction cost would take about 8 weeks. Projects between $250,000 and $500,000 would take 12-16 weeks. Larger projects in the $1,000,000 range could be expected to utilize large crews, and take 24-32 weeks. For Alternative E, the time premium for construction while the building is occupied is estimated to be 25-50% for the industrial group, 70-100% for the commercial group, and 100% for the residential group. The generally larger buildings for which occupancy during construction is more likely to be feasible would thus take about 3 to 15 months to retrofit.

C. PROGRAM-INDUCED DEVELOPMENT

1. INTRODUCTION

The implications of the various alternative seismic retrofitting requirements are not limited to direct construction period impacts. Owner decisions about their buildings, with or without a retrofit program, have environmental implications, particularly for longer-term loss of housing units and resulting residential displacement; loss of existing commercial space and resulting employment displacement; potential growth inducement through program-induced demolition of UMBs and replacement new construction of larger buildings; and potential loss of architecturally significant buildings. To assess the general magnitude of these potential impacts, an economic analysis was carried out (RHA 1990) to estimate building outcomes over the next 10-30 years, both without a UMB retrofit program (Alternative A, "no project", or "base case") and under the three mandatory retrofit EIR Alternatives C, D, and

E./2/ This analysis is discussed below as background to subsequent discussions in this EIR of various "program-induced development" impacts.

Requirements to spend money to complete the seismic retrofitting of a UMB would influence building owner decisions about the longer-term use of their property. Depending on current building occupancies as well as alternative uses for the buildings and their sites, owners of UMBs could decide to either complete the retrofitting work, or undertake the retrofitting project while also converting the building to a higher-rent paying use, or demolish the building for new development, or demolish the building and hold or sell the land because compliance with retrofitting requirements would not be feasible. In some cases, the UMB would have been converted or demolished for new development in any case, as part of the on-going pattern of land use change in the City. Requirements to retrofit could change a building owner's calculation of what to do with the UMB and when to act.

Analysis of building outcomes was undertaken to determine what difference the alternatives would make for the stock of UMBs in San Francisco and for the availability of various types of space and, thus, for tenants' choices over the longer term. The analysis plays out the consequences of alternative requirements to spend money to retrofit UMBs, considering current building occupancies, zoning and development potential, and real estate market conditions and trends. Depending on the building owners' assessment of those factors, and the magnitude of the required retrofitting expenditure, the disposition of the unreinforced masonry building stock could be different in the future than it would if that expenditure were not required.

Assumptions necessary to carry out the analysis and methodology used are contained in the background report /2/.

2. BUILDING OUTCOMES

Five categories were developed to describe longer-term building outcomes for the background economic and land use impact assessment, which cover the

range of possible building outcomes quantified in this analysis of UMBs. The building outcome scenarios for the base case (Alternative A) and for the three seismic retrofitting alternatives (C, D, and E) are summarized according to those categories. These categories are:

- UMB demolished for new construction
- UMB converted or altered, and retrofit to 104(f)
- UMB retrofit according to the particular alternative
- UMB at-risk
- UMB without retrofit

Demolished for new construction represents situations in which the UMB would be likely to be demolished to make way for a new development project. In many of those cases, the parcel on which the UMB is located would be combined with adjacent parcels to create a larger development site.

The category **converted or altered, and retrofit to 104(f)** is for situations in which, according to current City policy, UMBs converted to other uses or substantially altered or enlarged would have to complete seismic retrofitting to the standards of Section 104(f) of the current San Francisco Building Code. That is the same level of seismic upgrading that would be required of all UMBs under Alternative E. Conversions of UMBs to attract higher-rent-paying uses and alterations to accommodate more revenue-generating space are expected to continue in the future. If either Alternative C or Alternative D were implemented as the general seismic retrofitting requirement, UMB conversions or substantial alterations would still trigger Section 104(f) requirements. Under Alternative E, the category **retrofit to 104(f)** refers to cases in which the UMB would be converted or would be altered (with a penthouse addition, for example).

Retrofit per alternative means that the building owner would undertake the retrofitting project as required. No buildings would fall into this category in the base case scenario. In the Alternative E scenario, buildings in this category would be retrofit to the level of Section 104(f); those

104(f) cases involving conversion or alteration are identified separately, as described above.

At-risk means that the UMB would not be retrofit and would be at-risk of eventual demolition as a result of the retrofitting requirements. "At-risk" identifies situations in which the cost of retrofitting would exceed the value of the building. Consequently, there would be no incentive for owners to do the retrofitting. Generally, UMBs at risk would be buildings for which retrofitting costs would be relatively high and rental income from existing uses relatively low. In addition, other options for owners for those buildings would be limited (at least for some time into the future). In many situations, market demand for upgraded, converted, or new space in the area would be lacking. There also could be other prohibitive costs associated with changing uses or with new development (such as the requirement to replace residential units demolished for new construction). Thus, it would make more economic sense for owners of UMBs at-risk to demolish the building and hold or sell the land rather than to undertake the required retrofitting project. (Many owners with outstanding loans for UMBs at-risk probably would relinquish their interest in the building to the lender; the same economic assessment, resulting in demolition of the building, would apply to lenders.) "At-risk" does not apply in the base case scenario.

The extent and timing of demolition of UMBs at-risk would depend on enforcement of the retrofitting requirements and on the availability of economic assistance. In the absence of economic assistance that encourages retrofitting, many owners of "at-risk" buildings probably would not proceed with demolition until the City began proceedings against such properties that were not in compliance with the retrofitting requirement. While many UMB owners would move ahead with demolition at that point, there would be some situations in which owners essentially would abandon UMBs, leaving demolition and recovery of costs to the public sector through liens attached to the property. In those situations the speculative value of the land would be less than the costs to demolish.

Without retrofit applies, by definition, to Alternative A, the base case scenario, only. The category identifies buildings that would remain without retrofitting in the absence of retrofitting requirements. In the base case scenario, those are UMBs that are not either demolished for new construction, or preserved converted or altered and thus retrofitted according to Section 104(f).

Table IV-5 summarizes the results of the building outcome analysis for all commercial/industrial and residential UMBs. The table shows what would be likely to happen to unreinforced masonry buildings in San Francisco with no mandatory retrofitting requirements (Alternative A--the base case scenario), except in the case of conversions or alterations (seismic retrofitting required per Section 104(f) of the building code). The table shows what would be likely to happen to UMBs under each alternative. The estimates are given for both a shorter term period (1990-2000) and a longer term period (by 2020). The table shows that many building outcomes apparently generated by program alternatives in the shorter term would have occurred anyway (with or without a retrofit program) by 2020.

Through the year 2000, relatively few UMBs would be retrofit under Alternative A (only about three percent of the total). About 7% would be retrofit by 2020. Most of those are buildings that would be converted to higher-rent-paying uses, and therefore would be retrofit according to the requirements of Section 104(f) of the building code. In the expected course of development in San Francisco, some UMBs would be demolished for new construction between 1990 and 2000 (many of those UMBs are part of downtown projects that already have been approved), and a total of about 161 (8%) could fall into this category by 2020.

As Table IV-5 shows, the number of potential UMB demolitions and conversions under Alternative C would be slightly larger than that expected under Alternative A. Most buildings (90%) would be retrofit per the requirement. About 3% of the UMBs (50 buildings) would fall into the "at-risk" category. By 2020, virtually all of the buildings which would have

TABLE IV-5

RESIDENTIAL AND COMMERCIAL UMB
BUILDING OUTCOMES, BY ALTERNATIVE

Shorter term outlook: 1990-2000

Number of buildings (and percent of all 1,959 residential & commercial UMBs)

BUILDING OUTCOME (10 yrs.)	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Demolition/New Construction	48 (3%)	*	61 (3%)	75 (4%)	93 (5%)
Retrofit/Conversion of Use[a]	65 (3%)	*	86 (4%)	101 (5%)	136 (7%)
Retrofit per Alternative	NA	*	1762 (90%)	1651 (84%)	1333 (68%)
At Risk of Demolition[b]	NA	*	50 (3%)	132 (7%)	397 (20%)
Without Retrofit	1846 (94%)	*	NA	NA	NA
Total	1959	1959	1959	1959	1959

Longer term outlook: Totals in 2020

Number of buildings (and percent of all 1,959 residential & commercial UMBs)

BUILDING OUTCOME (30 yrs.)	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Demolition/New Construction	161 (8%)	*	162 (8%)	166 (8%)	178 (9%)
Retrofit/Conversion of Use[a]	127 (7%)	*	127 (7%)	129 (7%)	164 (9%)
Retrofit per Alternative	NA	*	1628 (83%)	1542 (79%)	1240 (63%)
At Risk of Demolition[b]	NA	*	42 (2%)	122 (6%)	377 (19%)
Without Retrofit	1671 (85%)	*	NA	NA	NA
Total	1959	1959	1959	1959	1959

Source: RHA 1990

NA = Not Applicable

* Alternative B numbers would fall between those of Alternative A and Alternative E, most likely close to Alternative A.

SEE TOP OF NEXT PAGE FOR TABLE NOTES

[a] UMBs converted to another use or with additions or substantial alterations that trigger seismic retrofitting requirements per Section 104(f) of the current San Francisco Building Code.

[b] UMBs at-risk eventually would be demolished. In the absence of economic assistance, they are unlikely to be retrofit, given the high costs of retrofitting relative to building value.

NOTES FOR TABLE IV-5:

The 48 UMBs with institutional uses are not included in this assessment. Institutions are generally not subject to purely economic development forces and are too individualistic to predict future outcomes of their buildings.

The numbers for Alternative A represent a "Base Case" which is forecast to occur with no UMB program or regardless of any program which may be adopted.

The numbers given are subject to errors due to uncertainties of forecasting; however the relationships among alternatives should be generally consistent and valid.

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been demolished for new construction or converted under the base case would do so under Alternative C as well.

Under Alternative D, somewhat more UMBs would be demolished for new construction or converted to other uses sooner than under Alternative A or Alternative C, although the differences by 2020 are negligible. More UMBs would be at-risk with the retrofitting requirements of Alternative D, compared to Alternative C, a total of 7% of all commercial and residential UMBs. About 84% of the buildings would be retrofit per this Alternative, and another 9% would be demolished for new construction or retrofitted to 104(f) through conversion or alteration by 2000.

Under Alternative E, there would be almost twice as much demolition for new construction between 1990 and 2000 as there would be under Alternative A. There would be more than twice as much program-induced conversion and alteration, because Section 104(f) seismic upgrading standards would be required in any case under this Alternative. However, most of these buildings would have undergone these outcomes anyway by the year 2020. Of more

importance, about 20% of the UMBs would be at-risk of eventual demolition as a result of Alternative E retrofitting requirements. About two-thirds of the buildings would be retrofit in response to the requirements by the year 2000.

Again, most of the UMBs estimated to be demolished for new construction or converted/altered and retrofit to 104(f) under Alternatives C, D, and E would have undergone the change in the longer term (2000-2020) under Alternative A. The various mandatory retrofit programs would, in most cases, induce these changes sooner. Buildings "at risk" of demolition represent the greater portion of potential program-induced effects.

D. GROWTH-INDUCING IMPACTS

Adoption of a UMB Program could indirectly generate growth depending upon owner decisions when faced with the costs and other factors associated with a retrofit requirement. In this context, growth inducement would occur through two potential changes: new construction (either after UMB demolition or in an addition to an existing UMB) and conversions of use (for example, from warehouse to office). These changes could occur if building owners decide that reinvestment of retrofit costs in their building warrants a conversion of use that would yield higher revenue, or if such costs are not warranted compared with costs and revenues associated with a new building on the UMB site. Such decisions by building owners are based upon a number of factors, including relative costs of various options, potential revenues based on market rents for various uses in the various UMB locations, size and configuration of the existing building and its lot, and other factors.

The UMB data base was analyzed in conjunction with analysis of existing and reasonably foreseeable locational and land use market factors and land use regulations in an attempt to forecast the building outcomes that could reasonably be expected under the various alternatives. Details of assumptions and methodology used are presented in the RHA 1990 report /2/, available for purchase or review at the Department of City Planning. The results for outcomes which could be considered growth inducing are presented in Table IV-6.

TABLE IV-6
BUILDING OUTCOMES CONSIDERED GROWTH INDUCING, BY ALTERNATIVE
Number of buildings (+ change over Alt. A base case)

Shorter term outlook: 1990-2000

OUTCOME (10 years out)	Alt. A[1]	Alt. B	Alt. C	Alt. D	Alt. E
Demolition/New Construction	48 (+0)	*	61 (+13)	75 (+27)	93 (+45)
Additions/Conversions of Use	65 (+0)	*	77 (+12)	85 (+20)	136 (+61)
Total UMB "growth sites"	113 (+0)	*	138 (+25)	160 (+47)	229 (+116)

Longer term outlook: Totals in 2020

OUTCOME (30 years out)	Alt. A[1]	Alt. B	Alt. C	Alt. D	Alt. E
Demolition/New Construction	161 (+0)	*	162 (+1)	166 (+5)	178 (+17)
Additions/Conversions of Use	127 (+0)	*	130 (+3)	133 (+6)	169 (+42)
Total UMB "growth sites"	288 (+0)	*	292 (+4)	299 (+11)	347 (+59)

1 The numbers for Alternative A represent a "Base Case" which is forecast to occur with no UMB program or regardless of any program which may be adopted.

* Alternative B numbers would fall between those of Alternative A and Alternative E, most likely close to Alternative A.

Note: The numbers given are subject to errors due to uncertainties of forecasting; however the relationships among alternatives should be generally consistent and valid.

Table IV-6 indicates that the number of conversion and demolition/new construction building outcomes would increase from Alternative A through Alternative E, though the total number of buildings in all cases is fairly small in the shorter term (10 years), about 25 buildings (1% of all UMBs) under Alternative C, about 47 buildings (2% of UMBs) under Alternative D, and about 116 buildings (6% of UMBs) under Alternative E. These changes would occur over a period of about 10 years, in scattered locations throughout the city. Most of these changes would have occurred anyway in the longer term (30

years, by the year 2020); a retrofit program would merely hasten the timing of this new development, as buildings which would have been redeveloped, say, 15 years from now would be redeveloped sooner when faced with a notice to retrofit. In this longer term outlook, very few buildings would have program-induced growth outcomes (four buildings under Alternative C, 11 buildings under Alternative D, and 59 buildings under Alternative E). Most of these buildings would undergo conversions of use, rather than demolition for new construction.

As was shown in Table IV-5, the number of potential program-induced building losses (buildings at risk of demolition without replacement -- discussed in the previous and following sections of this report) exceeds the number of growth inducing building outcomes, particularly in the longer term (30 years). That is, under Alternatives C, D and E, more buildings would likely be demolished as a result of the retrofit requirement than would new, larger buildings be built. Therefore, the end result would be a net loss of buildings, and most likely a net loss of building space. In light of the potential net loss of building space, and the small amount of development potential generated by any of the program alternatives, it is concluded that the growth inducing effect of any of the alternatives or combinations thereof would be minor, and no significant growth-associated impacts on transportation, air quality, or other environmental factors measurable in the overall program context of this analysis are foreseeable under any of the alternatives or possible combinations of alternatives.

E. DISPLACEMENT

Displacement of both existing residential and business occupants of UMBs can be expected under the various alternatives. Displacement would be caused by (1) retrofit construction due to vacating of buildings for construction work and (2) redevelopment, demolition, or conversion of UMBs due to owner decisions leading to certain building outcomes, as described in the previous section. Both types of displacement are discussed below.

1. DISPLACEMENT DUE TO RETROFIT CONSTRUCTION

a. Background.

For some of the alternatives, the level of physical disruption caused by the construction work required for retrofitting certain building types may dictate that some buildings be completely emptied during the work and others be partially vacated. Depending on numerous factors including the amount of displacement needed, the period of time over which displacement would occur, and the availability of suitable space in which to relocate, displacement of residents and employees could represent a loss of housing and employeymtn space, or generate the need for new facilities (with associated physical changes). Consequently, the potential for even temporary simultaneous displacement of large numbers of persons could lead to environmental effects that warrant examination in this EIR.

The following attempt to quantify displacement effects is constrained by considerable uncertainties. The situation of every owner, every building and every building user will be unique. Precise predictions of the timing and extent of displacement are not possible. Nevertheless, by utilizing a rational, conservative, approach to the analysis, rough estimates were obtained that provide bases to compare the alternatives.

An important basis for estimating levels of displacement is information provided by experienced engineers and contractors. The likelihood of

displacement during construction varies primarily by building size and secondarily by use. Generally, the smaller the building and building footprint, the more difficult it will be to perform the work with occupants in place, due to lack of sufficient space for staging work within a building. Also, the likelihood and desirability of vacating a building increases with the amount of work and disruption a particular retrofit requires. Consideration of building use is important for two reasons. First, certain uses are more sensitive to disruption caused by construction work. Second, different uses are apt to have different interior physical features, such as the number of partitions to be worked on, and the different levels of finish work needed to restore disturbed areas.

Retrofit work with occupants in place is more expensive when deciding whether to vacate their buildings for construction. Owners would have to consider the trade-off between faster, less costly retrofit if their buildings are vacated versus lost revenues, relocation requirements, lease provisions, and other factors.

All of the above considerations were taken into account in the assumptions made for status of building occupation during construction, presented in Table IV-4, page IV-15. As was indicated in Table IV-4, it is generally expected that Alternative C work can be completed with residential or business occupants in place. For Alternative D, only the smaller buildings with small plate sizes are expected to be emptied for retrofit work whether their general use is industrial (prototypes A and E), commercial (prototypes A and G) or residential (prototype A and K). The estimated number of buildings involved totals about one-quarter of the UMBs, although the number of units and uses affected would be substantially less than 25% of those totals because these prototypes represent the smallest buildings (most with floor areas of less than 2500 sq. ft).

Under Alternative E, it is estimated that almost half of the UMBs would be emptied for retrofit construction. These would include all UMBs assumed to be vacated under Alternative D, plus most UMBs of medium size. It is assumed,

based on the engineering considerations described above and information about the Los Angeles experience, that work would be phased within most of the larger UMBs, often with approximately one-quarter of the building being worked on and completed at a time.

Based on these considerations, the number of buildings in the UMB prototypes that have a high probability to be emptied during retrofit work are shown in Table IV-7. It must be understood that some of the buildings in the building prototypes assumed to be emptied for retrofit would in fact remain occupied, and some buildings in the prototypes assumed occupied would be emptied. The assumptions made are intended to generally estimate overall displacement effects, and are conservative in order to capture maximum likely displacement potential. Experience in Los Angeles has demonstrated that owners generally prefer to maintain maximum reasonable building occupation to retain at least some income during construction. Many tenants (commercial and residential) apparently have also preferred to stay in place, because as of early 1990, Los Angeles retrofit work (essentially the same as Alternative D) has been completed with at least some tenant occupation in a large proportion of the buildings./4/ A study of the Los Angeles experience found that the displacement that did occur was less than expected, and in some commercial areas, displacement was little different from turnover experienced during the same time in nearby non-UMBs not undergoing mandatory retrofit. Most commercial displacement that has occurred in Los Angeles appeared to be in response to increased rents associated with both retrofit and other, concurrent upgrading costs./5/ Generalizing from the L.A. experience should be done with caution, because most of the more difficult buildings to retrofit, both physically and economically, remain to be done.

Much of the observed residential displacement in Los Angeles also appeared to be largely due to increased rents or, more precisely, tenant expectation of increased rents after completion of retrofit work. The retrofit-related residential rent increases expected in San Francisco are likely to be different from those experienced in Los Angeles because there are fundamental differences between the two residential rent control regulations.

TABLE IV-7
NUMBER AND PROTOTYPE OF UMBs
ASSUMED TO BE OCCUPIED DURING CONSTRUCTION[a]

		ALTERNATIVE[b]			
		D		E	
Prototype[c]	Total Number	Number Occupied	Number Vacant	Number Occupied	Number Vacant
A	136	0	136	0	136
B	169	169	0	169	0
C	138	138	0	138	0
D	97	97	0	97	0
E	89	0	89	0	89
F	143	143	0	143	0
G	236	0	236	0	236
H	176	176	0	176	0
I	70	70	0	0	70
J	83	83	0	83	0
K	162	0	162	0	162
L	147	147	0	0	147
M	139	139	0	0	139
N	162	162	0	162	0
O	60	60	0	60	0
TOTAL	2007	1384	623	1028	979

Source: San Francisco Department of City Planning.

(a) The assumptions regarding the number and type of buildings that would be vacated versus partially occupied are simplifying assumptions based on building size (the smaller the building plate size the more difficult and expensive to perform construction with occupants in place). Actual program experience would not be all-or-nothing by prototype; but the total buildings vacated (30% vacant under D, almost 50% under E) is expected to be the reasonable maximum for purposes of assessment of dislocation and other impacts.

(b) The few buildings expected to be retrofitted under Alternatives A and B are expected to be vacant. Buildings are expected to be occupied for Alternative C.

(c) See the EIR's inner back cover for more detailed description of prototypes.

The vast majority of UMB dwelling units in both Los Angeles and San Francisco are subject to rent control. In Los Angeles, the costs of retrofit plus the costs for any other concurrent improvements made (in some cases, two to three times greater than the cost of retrofit) can be amortized and passed through to tenants within five years. Consequently, the amount of rent passthroughs in some cases there were quite high--up to $171 per unit per month. As of 1988, the average increase in Los Angeles was approximately $70 per month. /7/

San Francisco's guidelines for rent passthroughs for capital improvements cap such passthroughs at an annual ceiling of 10% of base rent regardless of the cost of the capital improvements. For example, for a unit costing $350 per month base rent, the passthrough would be limited to $35 per month during the year after completion of the work, regardless of how much the work cost. As long as the existing tenant remained in the UMB, the passthrough could be added to the base rent for each subsequent year until costs for the capital improvements were paid off. In many situations, rent passthroughs would be effectively capped when market rent for the particular unit is reached. Compared with the Los Angeles experience, this constraint on the dollar level of allowable rent passthroughs is considered likely to inhibit the amount of other work an owner would undertake concurrently with retrofit and is also likely to generally moderate any project-induced trends to upgrade an entire area. Implications of these rent increases for tenants are discussed in the RHA 1990 report./2/

b. <u>Residential Displacement</u>

(1) <u>Alternatives A and B.</u> For reasons discussed below, there is little potential for substantial residential displacement associated with either Alternative A or B. The voluntary retrofit construction activities associated with Alternatives A and B are expected to be at the level of current SFBC, Section 104(f) (Alternative E level), as indicated in the previous subsections on construction impacts of Alternatives A and B. Since these projects would be undertaken at owner discretion, the rate of undertaking and the types of buildings involved are assumed to be similar to those that are currently

witnessed for Alternative A and only slightly higher numbers for Alternative B. The historic annual rate of UMB compliance with SFBC, Section 104(f) is estimated at two to three buildings. To date, virtually all the buildings so retrofitted have involved conversions and major remodels of predominantly commercial buildings. Only one predominantly residential building is known to have recently complied with Section 104(f) and its seismic upgrade was a condition for receiving federal funding to renovate the building. This project was undertaken by a non-profit housing corporation in a partially occupied building. It is currently believed that a handful of similar projects by non-profit housing groups may be undertaken soon, but the voluntary retrofit rate for 104(f) is nonetheless expected to remain very small especially for buildings that are predominantly residential, because of high costs versus recoverable, expected returns. Most of the buildings which may be retrofitted under these Alternatives are expected to be emptied without involuntary displacement of occupants.

(2) Alternative C. Alternative C would involve mandatory retrofit of all UMBs, but with much less construction than that required for retrofits under any of the other alternatives. The extent of disruption, discomfort and inconvenience to some tenants affected by Alternative C would vary according to quality of design, planning and execution of a particular retrofit project, but displacement from buildings would normally not be necessary or expected. because of lost revenues, it is generally not expected that landlords would vacate buildings. Although a few landlords may consider vacating so that rents could be increased to market value, this practice is not expected to be widespread because there are already market forces in place to hold many of these rents down. The units are generally quite small, many have common kitchen facilities (if they have kitchens at all) and many are located in areas that do not command higher rents. It is possible that some tenants who reside in small units or particularly small buildings would be asked to use another unit in the building (accrued vacancies set aside for this purpose) for a few days while the work is phased through units to which construction access is needed. Occupants of many units would not directly be affected under Alternative C although persons remaining in place during the work would

be disturbed by noise, dust and work activity. In some cases, these disruptions could occur intermittently for as long as four to seven months in the large residential buildings. However, the disruptions are not likely to result in substantial dislocation. Therefore, a mandate to retrofit to the level of Alternative C is not expected to result in any noticeable demand for replacement housing.

(3) Alternative D. Alternative D is essentially the same general approach that has been implemented in Los Angeles since 1981 (with some modification over time) and utilizes the same construction activities. According to City of Los Angeles staff /4/, building vacancy during construction in the larger multi-unit buildings commonly began with a normal vacancy rate (less than 5%) plus vacancies accrued by owners in advance of work of up to a total of 10 to 12%. By the end of construction, vacancies typically rose to a total of approximately 25%. Thus, in Los Angeles, tenants moved from about 15% of the units during the construction period, in addition to the 10 to 12% of units accrued vacant prior to construction. These tenant moves were essentially voluntary, and were considered likely to have resulted from normal turnover plus persons who were bothered by living with construction disruption (especially in prolonged projects) plus persons who, in anticipation of rent passthroughs, secured other accommodations. Los Angeles staff reported that a large proportion of the residential buildings completed as of the end of 1989 were retrofit in occupied buildings. In some cases tenants were temporarily moved into another unit while theirs was being worked on or was inaccessible.

To predict residential displacement impacts in San Francisco under Alternative D, the following set of assumptions was formulated, based both on these reports of the experience in Los Angeles and on additional information provided by knowledgeable engineers and contractors. Voluntary moves from units prior to construction are assumed to consist of normal vacancies (3% for apartments, 9% for SROs and 40% for tourist units) plus owner-accrued vacancies up to a total of 12% for residential units and 100% for tourist units. The smallest buildings are assumed to be totally emptied prior to construction so that the work can be completed faster and more cheaply. For

the balance of UMBs, empty units in addition to those accrued (12% of the units) are likely to be needed. The R & C report suggested that the work conducted in occupied UMBs for both Alternatives D and E could most reasonably take place by building quadrant./1/ Consequently, the assessment assumes that an additional 13% of the units would be temporarily vacated through the legal right under the San Francisco Rent Stabilization Ordinance to evict tenants to perform capital improvements. The results of this assumption and estimation process are shown in Table IV-8 for Alternative D.

TABLE IV-8
ESTIMATED TEMPORARY RESIDENTIAL EVICTIONS
UNDER ALTERNATIVE D

SOURCE OF MOVE	TYPE OF TENANT MOVE	APT NO.	APT (%)[a]	SRO NO.	SRO (%)[a]	APT + SRO NO.	APT + SRO (%)[a]	TOURIST NO.	TOURIST (%)[a]
A. Normal Vacancies	Voluntary	329	(3)	979	(9)	1308	(6)	2170	(40)
B. Accrued Vacancies	Voluntary	988	(9)	326	(3)	1314	(6)	3256	(60)
C. Entire UMB Vacated[(b)]	Involuntary	745	(7)	395	(4)	1140	(5)	0	(0)
D. UMBs Partially Vacated	Involuntary	1062	(10)	1194	(11)	2256	(10)	0	(0)
Total Estimated Units Involving Involuntary Tenant Relocation (C plus D)		1807	(16)	1589	(15)	3396	(16)	0	(0)

Source: San Francisco Department of City Planning

(a) Percent of UMB units of this type.
(b) These are the units contained within the UMB prototypes (A, E, G and K) that are assumed to be emptied prior to construction for Alternative D. These numbers represent total units contained in the four prototypes minus 12% of the units already empty through normal vacancy (assumed at three percent for apartments and nine percent for SRO units) or accrued vacancies.

Over the course of a program compliance period (5 to 30 years) it is estimated that up to approximately 42% (11,400 units) of the UMB residential and tourist units could be temporarily vacant to complete construction

activities for Alternative D. The majority of these (71%) would result from voluntary moves by tenants. Approximately 5400 would be accrued vacancies in tourist units plus another 2600 accrued apartment and SRO vacancies. Only 10% (about 1150 units) of all residential vacant units would result from owner decisions to completely vacate the smaller buildings. The remaining 2250 units would be temporarily vacated in the larger UMBs in which construction is phased through a building. Table IV-8 shows the distribution of units contained in these buildings by type of unit, based on the assumptions discussed earlier. Total units expected to be vacated that could not be accommodated through accrual of vacancies would approximate 3400. It is assumed that tenants in these units would be subject to legal temporary evictions for periods ranging from one to three months.

The additional 5400 or so designated tourist units that are located in the UMBs slated to be emptied are not assumed to result in additional eviction. Instead, it is believed that these units would be vacancy accruals. Furthermore, 75% of the units classified as tourist units are located in the larger buildings comprising Prototypes C and N. To the extent these large UMBs are strengthened by building quadrant, as expected, there should be only minor affects on designated tourist unit users especially since such users tend to be transient.

There is limited experience on which to base estimates of the number of tenants that could be permanently displaced because of these temporary evictions. Documentation of the relevant Los Angeles experience is unavailable although anecdotal information has been obtained from persons involved in administering their ordinance. Displaced tenants were not systematically tracked in Los Angeles but it is believed that most moved elsewhere in the same neighborhood. It is also believed that displaced tenants found housing at similar rent but that either the housing quality and amenities were reduced or, in some cases, tenants doubled up to share rent in small quarters./4/ Because of these data limitations the following conservative assessment was conducted to assess residential tenant displacement.

Average household size for UMB units varies widely by study area; from a low of 1.4 in Downtown, North of Market and Bush Street Corridor to a high of 2.5 in the Mission/Upper Market (followed closely by 2.4 for apartments in Chinatown and the Outlying Areas). For purposes of residential tenant displacement assessment, the weighted average household size in the UMBs is estimated at 1.7 in apartment units and 1.3 in SRO units/2/.

Based on the household size assumptions presented in the setting section, approximately 5100 tenants would be temporarily evicted because of the work needed to comply with Alternative D. Many would undoubtedly return due to rent control, neighborhood and friendship ties, and other factors. However, conservatively assuming that virtually all would prefer to resettle permanently elsewhere, they would require access to a total of about 3400 units over the course of the program period, as follows:

TABLE IV-9
APPROXIMATE ANNUAL RESIDENTIAL TENANT MOVES
EXPECTED WITH ALTERNATIVE D
BY PROGRAM PERIOD

Program Period (Years)	Average Annual Involuntary Tenant Moves[(a)]	Average No. of Units Vacated Annually[(b)]	% of Total UMB Residential Units Vacated per Year[(c)]	% of City-wide units in multi-unit bldgs.
5 years	1000	675	3.0%	0.30%
10 years	500	350	1.6%	0.20%
15 years	350	225	1.0%	0.10%
30 years	175	125	0.5%	0.06%

Source: San Francisco Department of City Planning

(a) (5100 estimated evicted tenants) divided by (No. of years for program completion)

(b) This number of units is assumed to be vacated through evictions and does not include units that would likely be accrued through attrition prior to and during construction.

(c) This calculation ignores the 5400 tourist units, none of which are assumed to be subject to evictions.

These estimates assume that an even distribution of citations to require retrofit by prototype is issued and carried out over the compliance period i.e., for a 5-year program, one-fourth of the UMBs in each prototype would recieve notice to retrofit each year and would have one year to complete the work required. To the extent a particular program's priorities differed from this assumption, the unit demand associated with tenant displacement could be higher or lower in any given year. It is very important to note that the average number of units vacated annually should not be interpreted to imply that there would be a demand for that many new units each year, because (a) the demand numbers are small enough to be partially absorbed by normal rental vacancies in UMBs and non-UMBs, and (b) after retrofit work is completed in the initial buildings, the units in those buildings would be returning to the market. In the buildings that are estimated to be completely vacated, the work is expected to be completed within four to 12 weeks (although this duration could be two to three times longer if a general remodel of the building is also undertaken). Upon completion, the units would go back on the market at prevailing market rents (except when the original tenants exercise rights to reoccupy at no more than a ten percent base rent increase annually).

Consequently, impacts related to both tenant and housing unit displacement, while of social concern, are not considered substantial from an environmental review perspective. Because it is unlikely that available housing affordable to many displaced tenants will be sufficient to meet demand, program-related hardships to individual tenants or classes of tenants such as those on fixed income, elderly persons or the very poor could occur, and are discussed in detail in the RHA 1990 report/2/.

(4) Alternative E. Over the course of the compliance period (five to 30 years) approximately 13,200 units (excluding tourist units) could be temporarily vacant to complete construction. Alternative E construction activities could result in temporary evictions from approximately 40% of the residential units in UMBs for periods ranging from two to six months. Of the approximately 11,400 units that would need to be emptied (excluding tourist units), about 2600 vacancies would result from normal or accrued vacancies.

Approximately 7200 would result from entire buildings being vacated in order to perform the work, as indicated on Table IV-10. The balance of units that would need to be emptied during the work (approximately 1500 units) would be located in the larger buildings (primarily Prototypes C and N) where the retrofit activities could be performed in empty building quadrants. Tenants would likely be moved within the buildings to completed units. It is expected that most owners of these large residential buildings would choose this approach in order to maintain the maximum possible income stream during the relatively lengthy construction period.

TABLE IV-10
ESTIMATED TEMPORARY RESIDENTIAL EVICTIONS
UNDER ALTERNATIVE E

		TYPE OF UNIT							
	TYPE OF	APT		SRO		APT & SRO		TOURIST	
SOURCE OF MOVE	TENANT MOVE	NO.	(%)[a]	NO.	(%)[a]	NO.	(%)[a]	NO.	(%)[a]
A. Normal Vacancies	Voluntary	329	(3)	979	(9)	1308	(6)	2170	(40)
B. Accrued Vacancies	Voluntary	988	(9)	326	(3)	1314	(6)	3256	(60)
C. Whole UMB Vacated[b]	Involuntary	3544	(32)	3672	(34)	7216	(33)	0	(0)
D. UMBs Partially Vacated	Involuntary	795	(7)	761	(7)	1556	(7)	0	(0)
Total Estimated Units Involving Involuntary Tenant Relocation (C plus D)		4339	(40)	4433	(41)	8772	(40)	0	(0)

Source: San Francisco Department of City Planning

(a) Percent of UMB Units of this type

(b) These are the units contained within the UMB prototypes (A, E, G, I, K, L and M) that are assumed to be emptied prior to construction for Alternative E. These numbers represent total units contained in the seven prototypes minus 12% of the units already empty through normal vacancy (assumed at three percent for apartments and nine percent for SRO units) or accrued vacancies.

According to the same conservative assumptions applied for Alternative D (average household sizes of 1.7 and 1.3, respectively for apartments and SROs, same compliance timeframes, and no return of tenants that are temporarily evicted to their former units), approximately 13,100 persons would be evicted due to the upgrade work for Alternative E. Conservatively assuming 100% of these tenants move elsewhere permanently, the average annual number of program-caused vacated units under the different program timeframes would be as follows:

TABLE IV-11
APPROXIMATE ANNUAL RESIDENTIAL TENANT MOVES
EXPECTED WITH ALTERNATIVE E
BY PROGRAM PERIOD

Program Period (Years)	Average Annual Involuntary Tenant Moves (a)	Average No. of Units Vacated Annually(b)	% of Total UMB Residential Units Vacant Per Year(c)	% of Ci- wide un s in mult unit bl s
5 years	2625	1750	8.0%	0.8%
10 years	1300	875	4.0%	0.4%
15 years	875	600	2.7%	0.3%
30 years	450	300	1.3%	0.1%

Source: San Francisco Department of City Planning

(a) (13,100 estimated evicted tenants) divided by (No. of years for program completion)

(b) This number of units is assumed to be vacated through evictions and does not include units that would likely be accrued through attrition prior to and during construction.

(c) This calculation ignores the 5400 tourist units, none of which are assumed to be subject to eviction.

As stated earlier in the discussion of Alternative D, one of the key assumptions made in this assessment is that there would be an even distribution of units being vacated over the compliance timeframe. In practice, buildings would probably be cited for and carry out retrofit at uneven rates, which would cause fluctuations in the number of tenants needing relocation housing at any one time.

The estimated average number of units vacated per year would be split almost evenly between small apartment units and SRO units in residential hotels. Reported vacancy rates in SRO units in 1988 were between 14-18%./8/ This indicates that affected single tenants may have more options than multi-tenant or family living units that cannot normally be accomodated in SROs.

Alternative E could cause a substantial amount of residential displacement if compliance timeframes of five to ten years are selected. Of the mandated progams being considered, Alternative E is the most costly, most disruptive and has the longest duration to complete construction work. Resulting tenant impacts would require temporary eviction of about 41% of the UMB residents for periods ranging from two to six months. This time period range could more than double in cases where building remodels and upgrades were undertaken simultaneously. Under this alternative, it appears unlikely that available housing affordable to displaced tenants could accommodate the demand, particularly if the program period is 10 years or less. Because of the substantial number of persons involved, and because the length of construction time during which tenants would be displaced would be the longest of the alternatives for most buildings, this impact is considered significant. The City's ability to provide adequate social services for this number of people would be strained. Some persons could end up having to leave San Francisco, and others with few resources could end up homeless.

C. Employment Displacement. Available information and insights from the Los Angeles UMB retrofit program are more limited for employment displacement than for residential displacement. Consequently, the following assessment and assumptions rely most heavily on engineer and contractor judgements about the likelihood of building occupancy during retrofit. These judgements take into account such variables as building size, floor plate size and primary use, and the differential cost, duration and disruption that would result from the alternative retrofit levels both with and without occupancy during construction. Although retrofit with occupants in place is technically feasible under any of the alternatives, it is estimated that, depending on the

level of retrofit required, some buildings would be totally emptied and most others would be partially vacated through accumulated attrition of tenants specifically in advance of scheduling construction work.

Documentation of business tenant displacement trends, based on several case studies of the Los Angeles experience in implementing its UMB retrofit program, found that UMB owners often chose to do the seismic work with tenants in place even though added time and costs were incurred /5/. Despite the often very disruptive nature of the work, business tenants in most cases apparently preferred to stay in place rather than relocate.

Given the data limitations, the approach used in the assessment is conservative and may therefore overstate employment effects. However, it is believed that the conclusions can be validly used for general comparisons among the alternatives.

(1) Alternatives A and B. For the same reasons discussed previously for residential displacement, there is little potential for these alternatives to cause substantial employment displacement. Under Alternative A there would be no mandate to strengthen UMBs to better withstand earthquake forces, so it is expected that few UMBs would be strengthened. Presently, approximately two to three per year are strengthened in accordance with the SFBC Section 104(f) which requires retrofit for buildings where a change in use or use intensity is proposed by an owner. Construction to achieve this level of strengthening would generally be quite disruptive. UMBs retrofit under Alternative A are expected to be vacated at least partially as work is phased, although most buildings that have already been upgraded to meet the SFBC level 104(f) have been vacated entirely since the retrofit work has most often been associated with major renovations.

The voluntary upgrade program of Alternative B would probably encourage more retrofits than Alternative A. Nonetheless, since the level of retrofit required for Alternative B is the same as for Alternatives A and E, it is expected that such work would usually be undertaken only when a major

renovation of a UMB is warranted, according to trends in the real estate market. Generally such a decision is expected to be made at the normal end of commercial leases. Displacement of businesses during the construction work would be for periods of two to six months, and in most cases, the prior leasee is not expected to return.

(2) Alternative C. The level of disruption expected with Alternative C work would not, in most cases, require that a building be vacated. The work could be disruptive for a few weeks to a few months but the extent and duration of disruption to building occupants would be the least of all of the five alternatives. Dislocations are generally not expected unless the owner elects to do additional work to remodel or renovate at the same time that retrofit work must be done. Such additional work is considered more likely to occur with the increased construction associated with the other alternatives.

(3) Alternative D. The smallest UMBs are expected to be vacated during the construction activities associated with this alternative whereas mid-sized and larger UMBs are expected to provide sufficient space to enable the work to be phased through the buildings. In those UMBs that are not vacated entirely, short-term business closure may be necessitated for one to two weeks or relocation within the building may occasionally be necessitated but major dislocation would not be expected.

Based on their small plate size, prototypes A, E, G and K are the likeliest buildings to be totally emptied prior to construction (see the EIR's inner back cover for a description of these prototypes). If all 623 UMBs in these prototypes were to be vacated then approximately one-fifth to one-fourth of the businesses (1000) would be involved. Some owners may try to undertake this work at the time a tenant leaves voluntarily at the end of a normal lease period, but since there is no known basis to predict the extent of voluntary business moves, the assessment assumes that all businesses in these building types would be dislocated temporarily. These 1000 businesses are estimated to contain about 11% of the jobs (5000 jobs) located in UMBs.

It is not known how many of the businesses that would be dislocated for a period estimated to be four to 12 weeks would seek different permanent quarters. The key parameters of a business owner's decision making are likely to include the cost of the old space versus equivalent space, availability of suitable space in which to relocate, whether or not essential equipment or fixtures had to be moved to accommodate the retrofit, and whether or not the business' locale is an element of its success. For example, many of the UMB businesses appear to be neighborhood-serving restaurants, bars, markets, beauty shops, and cleaners. Given the relatively short time period that many buildings would need to be emptied it is quite possible that some businesses--particularly those that are neighborhood dependent--may endure the temporary closure. However, it is assumed that most businesses, once displaced, would relocate permanently. Based on this assumption and assuming that there is an even distribution of business displacement over the compliance period, 250 businesses would need to relocate per year with the shortest, five-year compliance period. As indicated in Table IV-12, approximately 1250 employees would be dislocated annually, less than one-fifth of one percent of the jobs in San Francisco. Such relatively small levels of business and employment displacement--while possibly creating personal hardships for some owners and workers and some economic effects--would not constitute a substantial displacement effect.

TABLE IV-12
APPROXIMATE ANNUAL BUSINESS AND EMPLOYMENT MOVES
WITH ALTERNATIVE D BY PROGRAM PERIOD

Program Compliance Period (Years)	Average Annual Businesses Displaced	Average Annual Jobs Displaced	Percent of Citywide Jobs
5	250	1250	0.21
10	110	560	0.10
15	70	350	0.06
30	35	175	0.03

Source: San Francisco Department of City Planning

(4) Alternative E. Under Alternative E, it is assumed that, in addition to the UMB prototypes (A, E, G, and K) which would be vacated for Alternative D retrofits, three additional prototypes (I, L and M--see EIR's inner back cover for prototype descriptions) would be evacuated for construction due to a higher level of intrusiveness of the construction activities.

As indicated in Table IV-13, the displacement effects for Alternative E with a five year program would nearly double compared with Alternative D for both businesses and jobs.

TABLE IV-13
APPROXIMATE ANNUAL BUSINESS AND EMPLOYMENT MOVES
WITH ALTERNATIVE E BY PROGRAM PERIOD

Program Compliance Period (Years)	Average Annual Businesses Displaced	Average Annual Jobs Displaced	Percent of Citywide Jobs
5	425	2230	0.38
10	190	990	0.17
15	120	640	0.11
30	60	310	0.05

Source: San Francisco Department of City Planning

With a five-year program, less than one-half of one percent of San Francisco jobs could be temporarily displaced annually for periods ranging from four to 12 weeks. For longer term programs, the annual dislocations would be proportionately fewer. The number of jobs subject to displacement could be higher or lower in any given year depending on varying rates of retrofit activity and the number of businesses located in the particular buildings being strengthened in that year. As with Alternative D, when considered as part of the citywide picture, such relatively small levels of business and employment displacement--while possibly creating personal hardships for some owners and workers and some economic effects--would not constitute a substantial displacement effect.

d. Institutional Displacement. Forty-eight of the UMBs are classified as institutional uses (two hospital accessory UMBs, 32 religious uses, 3

residential care facilities, and 11 private school/day care uses). Of the 14 UMBs that contain schools (three in churches), ten serve elementary school children (approximately 2800 students), two are senior high schools serving 180 students, one serves 40 students in vocational training and one serves 90 pre-school children.

As a direct result of retrofit construction activities there is some potential for dislocation of existing institutional uses from the UMBs. Under retrofit Alternatives A and B, it is expected that no efforts to seismically strengthen buildings used by these institutions would be undertaken. The costs would be high--especially in prototype O assembly buildings--and there would be no known market return for the costly investment. However, it is possible that some of these buildings could be demolished and replaced by institutions with sufficient funds and sufficient need to do so.

Given the particular prototypes that house these institutions few would be subject to complete dislocation during construction, although some churches could need alternative meeting spaces during retrofit work under Alternatives D and E, and for those remaining in place, construction would need to be carefully scheduled to enable reasonably normal operations. Construction in most buildings used for schools could be scheduled during vacations or other periods of low usage. Alternative C work could take place with building occupation so displacement is not expected.

Most of the UMBs used for religious purposes fit the long, open span assembly prototype (prototype O). These buildings are generally relatively open and large and could accommodate phased construction. Of the other buildings, only 4 are located in the prototypes that are assumed to require a building be vacated during construction.

One school that is located in a small, one-story UMB would probably need to be vacated during the four or so week construction periods for Alternative D. This work could probably be scheduled during a school vacation period. The same school plus another school and two churches may be displaced for

Alternative E level construction for periods of approximately four to eight weeks, unless work could be scheduled for times other than assembly use and reasonable building access and utility can be maintained.

2. DISPLACEMENT DUE TO PROGRAM-INDUCED DEVELOPMENT

Based on longer-term, program-caused building outcomes from the analysis of program-induced development, summarized in Section IV.C. (detailed in the RHA 1990 report /2/), the following subsections compare expected housing and employment displacement that could result from demolitions or conversions that might occur under each alternative.

a. Residential Displacement. City zoning controls and policies designed to protect the existing housing stock would limit development options open to owners of residential UMBs. Residential UMBS are concentrated in areas where demolition of existing residential units is prohibited; where conditional use procedures are required for demolition or conversion of housing; or where height and density limits have been set close to prevailing building envelopes to discourage loss of existing housing. In addition, the Residential Hotel Conversion and Demolition Ordinance incorporates substantial disincentives to removal of residential hotel units, many of which are UMBS. Consequently, demolition for new development or conversion of residential UMBs under any of the alternatives would be limited.

Because the cost of retrofitting many residential UMBs would be high relative to expected rental income, and because development options are more limited for these buildings as discussed above, substantial numbers of residential UMBs would be at risk of eventual demolition without replacement development, particularly under Alternatives D and E.

Table IV-14 shows the estimated number of units in residential buildings (excluding tourist hotel units and the few units located in commercial buildings) that could be subject to demolition or conversion under each alternative.

About 1% of UMB residential units would be at risk of demolition under Alternative C. Under Alternative D, 12% of the units would be at risk with the South of Market, North of Market, and Chinatown areas having relatively high concentrations. Under Alternative E, one-half of the units would be at risk, including a substantial majority in the North of Market area and parts of South of Market.

TABLE IV-14
ESTIMATED LOSS OF EXISTING RESIDENTIAL UNITS
DUE TO PROGRAM-INDUCED DEVELOPMENT, BY ALTERNATIVE

	Number of Units (and Percent of UMB Units)[a]		
	Alt. C	Alt. D	Alt. E
BUILDING OUTCOME	No. (%)	No. (%)	No. (%)
Demolished or Converted	129 (<1%)	691 (3%)	1,321 (6%)
At risk of Demolition without Replacement	78 (<1%)	1,911 (9%)	9,914 (46%)
TOTAL UNITS AFFECTED	207 (1%)	2,602 (12%)	11,235 (52%)

Source: RHA 1990

[a] Based on the total number of residential UMB units (21,755), which excludes the small number of units located in predominately commercial buildings.

The large number of residential UMBs at-risk is explained by relatively low rents (partly due to the limits imposed by the Residential Rent Stabilization Ordinance) by relatively high costs of retrofitting and by lack of development potential to provide alternatives to retrofitting. The presence of residential rent control makes a difference in building outcomes to the extent that rents for occupied units are below market levels. Rent control would make the most difference in buildings occupied by many long-term tenants. That would be the case for apartments in Chinatown, North Beach, and parts of the North of Market area, and in other residential UMBs scattered throughout the City. The impacts of residential rent control on the likelihood that UMBs in Chinatown and North Beach would be at risk and eventually demolished would be moderated somewhat by the income generated from ground-floor commercial space, particularly along busy commercial streets.

Loss of residential units due to program-induced demolitions represents only part of the impact that a retrofit program would have on the housing stock. Although increasing levels of strengthening would lead to progressively more housing units lost, such losses must be balanced against housing "saved" from future earthquake destruction. The trade-off involving buildings lost due to program-induced demolitions and buildings saved due to program-induced building survivability is one of the essential decisions to be made regarding the UMB program alternatives.

As discussed in more detail in the Geology/Earthquake Hazards Impact section (IV.F.), engineering research estimates of UMB earthquake losses under Alternatives A, C, D, and E have been made specifically for the purpose of UMB alternatives analysis. These estimates were made both on a statistically expected <u>annual</u> basis (considering probabilities of all earthquakes from all faults affecting San Francisco), and for scenario earthquakes of 7.0 on the northern Hayward Fault and 8.3 on the northern San Andreas Fault. The annual loss estimates provide the most rational method to factor in the uncertainties as to precisely when damaging earthquakes might occur. Expressing losses on an expected annual basis provides the statistical ability to determine how long it would probably take for the buildings saved by the various retrofit alternatives to equal and surpass the program-induced building losses. Expressing losses in a scenario, however, tends to be more understandable.

The engineering research work indicates that retrofit would "save" from earthquake loss, on a statistically expected <u>annual</u> basis (considering probabilities of all earthquakes from all faults affecting San Francisco), 112 residential units annually under Alternative C, 139 under Alternative D, and 148 under Alternative E. When studied in comparison with the program-induced residential unit losses shown in Table IV-14, it can be seen that Alternative C strengthening would save from expected earthquake loss as many units as it could lead to demolition in only two years. Under Alternative D, it would take about 19 years for the expected units lost to demolition to balance the expected units saved from earthquake loss, and under Alternative E, it would take about 76 years.

In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, about 3170 residential units would be lost under Alternative A, 480 under Alternative C (= 2690 units "saved"), 155 under Alternative D (= 3015 "saved"), and 50 under Alternative E (= 3120 "saved"). Given such an earthquake (considered the most likely scenario to occur over the next 30 years), Alternative C would save about 13 times as many units as it would put at risk of demolition due to its cost, Alternative D would save roughly 600 more than would be lost, and Alternative E would generate program-induced losses 3-4 times greater than it would save (representing a net loss of about 8,000 units, a significant loss of housing stock).

Employment Displacement. Table IV-15 shows the number of businesses potentially displaced by program-induced development, redevelopment or demolitions over the course of the compliance period (five to 30 years).

Under Alternative C, about two percent of all businesses in UMBs would be subject to displacement; under Alternative D, six percent, and under Alternative E, about 19%. Lower vacancies and higher rents for certain types of commercial space would occur, particularly under Alternative E. Economic implications are discussed in RHA 1990./2/

TABLE IV-15
DISPLACEMENT POTENTIAL FOR BUSINESSES DUE TO PROGRAM-INDUCED DEVELOPMENT, BY ALTERNATIVE

	Number and Percent by Alternative		
	C	D	E
BUILDING OUTCOME	No. (%)[a]	No. (%)[a]	No. (%)[a]
Demolition/new construction	21 (<1%)	40 (<1%)	76 (2%)
Upgrades/conversions	14 (<1%)	20 (<1%)	85 (2%)
At risk of Demolition Without Replacement	68 (2%)	202 (4%)	701 (16%)
TOTAL BUSINESSES AFFECTED	103 (2%)	262 (6%)	862 (19%)

Source: San Francisco Department of City Planning, based on RHA 1990

(a) Percentage based on 4500 businesses in UMBs. Total percentages will not necessarily match due to rounding to nearest whole number.

According to the engineering research work discussed earlier under residential displacement, retrofit would "save" from earthquake loss, on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), building space containing 44 businesses annually under Alternative C, 56 under Alternative D, and 59 under Alternative E. When studied in comparison with the program-induced business displacement shown in Table IV-15, it can be seen that Alternative C strengthening would save from expected earthquake displacement as many businesses as could be displaced due to program-generated demolition in about 2-3 years. Under Alternative D, it would take about 4-5 years for the expected businesses displaced by earthquakes to balance the expected number saved from earthquake displacement, and under Alternative E, it would take about 15 years.

In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, about 1445 businesses would be displaced under Alternative A, 330 under Alternative C (= 1115 businesses "saved" from displacement), 70 under Alternative D (= 1375 "saved"), and 30 under Alternative E (= 1415 "saved). Given such an earthquake, Alternative C would save from earthquake displacement about 11 times as many businesses as it would put at risk of displacement due to program-induced development, Alternative D would save roughly five times as many as it would displace, and Alternative E would save about one and one-half times to twice as many as it would displace.

C. Institutional Displacement. While not quantified, it is expected that under Alternatives C, D, and E, respectively, increasing numbers of institutions would be dislocated from their present UMB space due to inability to pay the costs of retrofit. Churches and schools, in particular, would probably sell their UMBs and relocate, in such circumstances. Certain long-established religious uses of historic church buildings could be adversely affected, and the buildings placed at risk of demolition.

F. GEOLOGY/EARTHQUAKE HAZARDS

1. ESTIMATED FUTURE UMB DAMAGES AND CASUALTIES.

The following loss estimates for UMBs are provided for four of the five alternatives being considered. The estimates were provided by Rutherford & Chekene consulting engineers, under contract to the Department of City Planning (R & C 1990). Numerous assumptions were made for the modelling effort and they are also detailed in the background report.

The data generated for these studies should not be reproduced or used in any way without consideration of the limitations in accuracy. For instance, it is believed that estimates of deaths for large earthquakes could have an error factor of two and for smaller earthquakes a factor of four. In other words, the casualty estimates could range from one-quarter to four times those given in the tables which follow. Nevertheless, comparisons among the alternatives are considered valid because the assumptions are consistent for each alternative. Following is a brief summary of the R & C approach to loss estimation for the UMB studies and a description of the results.

a. Methods of Loss Estimation. Damage has been estimated using a computerized Seismic Risk Model (SRM) that considers shaking intensity at each building site and damage characteristics of each building prototype. Local shaking intensity is estimated using calculated fault distances, standard attenuation relationships, and site soil condition. Given the location and characteristics of each fault source, local shaking intensities were estimated for specific scenario earthquakes, but also on a probabilistic basis for all events. Both the estimation of intensities for any event and the expected damage can have large variations. For this study, both have been taken to be average values.

Building damageability was estimated considering prototypical building characteristics and other specific attributes contained in the UMB database. Sensitivity analyses considered the reasonableness of model results with

available damage and casualty data from previous earthquake loss studies and from the Loma Prieta Earthquake. Model adjustments were also made to consider the generally good quality of original construction of San Francisco UMBs compared with other communities.

Damage was estimated probabilistically, reported on an annual expected loss basis, and also for specific earthquakes. Relationships were developed between building damage and casualties as well as building damage and loss of building use. Casualties were estimated considering occupants inside the buildings and persons outside the buildings, building use, and time of day. A formula for estimating loss of building use was also developed, based primarily on experiences after the Loma Prieta earthquake. The formula considers the time involved for structural evaluation and permitting delays, reasonable damage repair rates, and critical loss levels likely to result in building demolition.

Results on the following loss parameters were provided from the modeling:

Property Loss (%):	Building damage as a percentage of replacement cost.
Property Loss ($):	Percentage damage times area times replacement cost per square foot.
Casualties Building (#):	Number of deaths expected to occur inside UMBs.
Casualties Street (#):	Number of deaths expected to occur on the street caused by damage to UMBs.
Hospital Injuries (#):	Number of injuries requiring hospitalization (assumed as 4 times the total number of deaths).
Occupant Days Lost (Occ.-days):	An accumulation of the number of days of functional building loss multiplied by the associated occupancy. The category only considers days lost in buildings that are assumed to be repaired (short-term loss).

Long Term Loss-Area:	The square footage that is expected to receive greater than 50% damage (40% for unstrengthened buildings) and may therefore be demolished or repaired only after a long delay.
Long Term Loss-Occ. Affected:	The number of occupants affected by Long Term Loss-Area. Calculated as the Long Term Loss-Area multiplied by the appropriate occupant load.

There is limited empirical data on building performance and its relationship to these loss parameters. Assumptions were necessary to generate the detailed damage, casualty, and downtime data contained herein. Most of the assumptions involve technical engineering judgements. The assumptions made are detailed in the background engineering report (R & C 1990). Based upon several calibration runs, the overall model results had a good "fit" with the actual effects of the Loma Prieta earthquake. Minor adjustments to some numerical coefficients were made as a result of comparing the initial output with estimates from the most documented studies of Bay Area earthquakes (the recent Loma Prieta earthquake and a Richter Magnitude 8.3 on the San Andreas fault).

The database for each UMB identifies several items that are important determinants of expected losses and consideration of these individual UMB features were explicitly included in the damage model. Important UMB features include underlying soil conditions, the nature of adjacent building characteristics (e.g. UMB or non-UMB, taller or shorter, etc.), and differential street and building occupancy densities based on UMB use, location, time of day and day of week. The generalized modelling procedure is depicted in Figure IV-2.

b. Loss Estimates. Loss tables were generated for each selected case study earthquake and for each strengthening alternative. The earthquake characteristics include fault source, magnitude and time of day. Modelling runs were performed for the following cases: 1) Annual Expected Losses

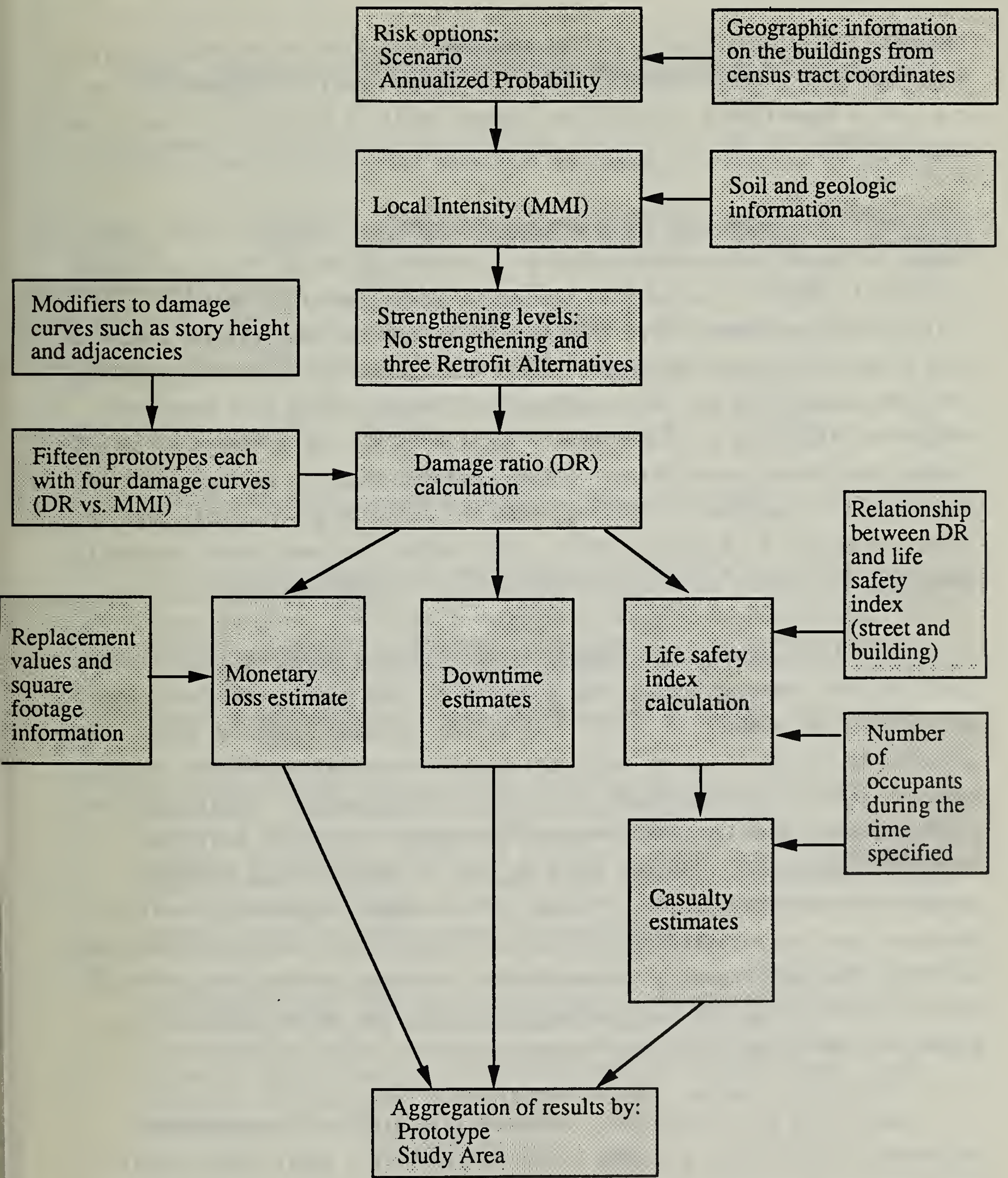

Figure IV - 2 Summary of Seismic Risk Model for Damage Estimation

probable losses, considering all earthquakes, reported on an annual basis); 2) Magnitude 7 on Hayward Fault at 3 a.m.; 3) Magnitude 7 on Hayward Fault at 3 p.m.; 4) a Magnitude 8.3 on the San Andreas Fault at 5:30 p.m. (probable worst case).

Tables IV-16 through IV-19 present the results. In each table, the damage estimates are expressed both as a percentage of building replacement cost and in dollars. Casualties are expressed as number of deaths (fatalities) and number of persons seriously injured (hospitalized injuries). Also given is the area and number of buildings expected to receive greater than 50% damage (40% for unstrengthened buildings), which as a group are considered likely to be demolished or not functional for a time considerably longer than normal repair time. (It was assumed that, if an investment has been made to strengthen a building, then the building would likely need to sustain somewhat more damage (50% vs. 40%) before the owner would decide to demolish it or leave it non-functional for an extended period).

Table IV-16 presents the annual expected losses under each alternative. Statistically expected losses over a period of time can be calculated by multiplying the numbers in Table IV-16 by the selected number of years. For example, in any ten year period, statistically expected earthquake losses in UMBs (if none are strengthened) would total nearly one-half billion dollars ($468,000,000), and 126 fatalities and 502 hospital injuries would be expected. About 240 buildings could be lost to demolition or rendered unusable for extended periods of time. These numbers represent statistical averages based on expected ground shaking intensity and earthquake recurrence intervals from all known earthquake faults affecting San Francisco. The actual losses in any ten year period or from any one earthquake could be higher or lower than statistical expectations.

Table IV-16 also shows that, compared with existing unstrengthened buildings, retrofitting all UMBs to the Alternative C level would result in about one-half the deaths and injuries and two-thirds the property damage; Alternative D would result in about one-sixth the deaths and injuries and

TABLE IV-16
ANNUAL EXPECTED UMB EARTHQUAKE LOSSES, UMB PROGRAM ALTERNATIVES

All numbers in this table represent the statistical average expected losses in one year from all potential earthquakes affecting S.F.[a]

Alternative	Property Losses in %[b]	Property Losses in $1,000	Deaths[c]	Hospital Injuries	Likely Demolished Sq.Ft.[d]	Likely Demolished (# Bldgs)
A- No Retrofit	1.6%	$46,800	12.6	50.2	419,900	(24)
B- Voluntary	Not quantified but slightly less than Alternative A					
C- Wall anchors	1.1%	30,900	6.0	23.9	126,100	(7)
D- UCBC-Draft 7	0.7%	20,700	1.7	6.8	50,000	(3)
E- Sec. 104(f)	0.6%	15,700	1.1	4.2	31,000	(2)

Source: Adapted from R & C 1990.

(a) The expected losses in X years equals approximately X times the figures in this table. For example, Alternative A lossess in ten years would be ten times greater than these loss and casualty figures. Expected earthquake caused deaths in or outside San Francisco UMBs are statistically expected to be 126 deaths by 1999.

(b) Property loss expressed as a percentage of UMB stock replacement cost.

(c) Includes all UMB-related deaths, both inside and outside the buildings. The number of deaths are estimated to be accurate within a factor of 2 at the high end (large earthquake, large number of deaths) and within a factor of 4 at the low end (small earthquake, small number of deaths). However, the relative relationships among the different alternatives are constant and valid for comparative purposes despite these ranges of uncertainty.

(d) The area of UMBs expected to receive damage greater than 40% of replacement cost (50% for strengthened buildings) and therefore considered likely to be demolished or non-functional for considerably longer than normal repair time. Dividing the area as given in square feet by the average UMB size yields a very rough estimate of the number of buildings in this category, given in parentheses.

slightly less than one-half the damage; and Alternative E would result in about one-eighth the deaths and injuries and one-third the damage.

Put another way, Table IV-16 shows that, compared with unstrengthened buildings, Alternative C would save a statistical average of about 6 lives annually, Alternative D would save 4 more than Alternative C (10 more than not strengthening), and Alternative E less than one more life annually than Alternative D (11 more than not strengthening).

To understand building performance in a given earthquake, loss calculations were performed for scenario earthquakes: a magnitude 7.0 on the Hayward Fault at 3:00 a.m. and 3:00 p.m., and for a magnitude 8.3 on the northern San Andreas fault (comparable to the 1906 earthquake) at 5:30 p.m. The results are given in Tables IV-17, IV-18 and IV-19.

As Tables IV-17 and IV-18 indicate, expected UMB-related deaths and injuries in a 7.0 earthquake on the Hayward fault depend on the time of day that the event will occur. Casualties are much lower at night because considerably fewer people are in the office, commercial, and assembly buildings and very few people are on the street. Building damage, of course, would be the same. Alternatives C, D, and E would save increasing numbers of lives as well as substantially reduce the number of likely UMBs beyond repair compared with the no project alternative.

Table IV-19 shows the expected UMB losses in a 5:30 p.m. magnitude 8.3 earthquake. Compared with existing unstrengthened buildings, retrofitting existing UMBs to the Alternative C level would reduce casualities by about 45% and long term building loss by approximately 70%. For this large an earthquake (similar to the 1906 event; estimated to be the maximum credible earthquake affecting San Francisco) the results of Alternatives D and E would be to reduce casualties by 85 to 90% and loss of buildings by 90 to 95%, respectively.

TABLE IV-17
EXPECTED UMB EARTHQUAKE LOSSES, UMB PROGRAM ALTERNATIVES
Magnitude 7.0 Earthquake, Hayward Fault, **3:00 p.m.**

Alternative	Property Losses in %[a]	Property Losses in $1,000	Deaths[b]	Hospital Injuries	Likely Demolished Sq.Ft.[c]	Likely Demolished (# Bldgs)
A- No Retrofit	29%	$838,000	438	1751	9,230,000	(534)
B- Voluntary	Not quantified but slightly less than Alternative A					
C- Wall anchors	22%	619,000	203	813	1,920,000	(111)
D- UCBC-Draft 7	14%	405,000	44	177	430,000	(25)
E- Sec. 104(f)	10%	297,000	23	92	154,000	(9)

TABLE IV-18
EXPECTED UMB EARTHQUAKE LOSSES, UMB PROGRAM ALTERNATIVES
Magnitude 7.0 Earthquake, Hayward Fault, **3:00 a.m.**

Alternative	Property Losses in %[a]	Property Losses in $1,000	Deaths[b]	Hospital Injuries	Likely Demolished Sq.Ft.[c]	Likely Demolished (# Bldgs)
A- No Retrofit	29%	$838,000	60	242	9,230,000	(534)
B- Voluntary	Not quantified but slightly less than Alternative A					
C- Wall anchors	22%	619,000	25	100	1,920,000	(111)
D- UCBC-Draft 7	14%	405,000	8	31	430,000	(25)
E- Sec. 104(f)	10%	297,000	5	20	154,000	(9)

Source: Adapted from R & C 1990.

(a) Property loss expressed as a percentage of UMB stock replacement cost.

(b) Includes all UMB-related deaths, both inside and outside the buildings. The number of deaths are estimated to be accurate within a factor of 2 at the high end (large earthquake, large number of deaths) and within a factor of 4 at the low end (small earthquake, small number of deaths). However, the relative relationships among the different alternatives are constant and valid for comparative purposes.

(c) The area of UMBs expected to receive damage greater than 40% of replacement cost (50% for strengthened buildings) and therefore considered likely to be demolished or non-functional for considerably longer than normal repair time. Dividing the area as given in square feet by the average UMB size yields a very rough estimate of the number of buildings in this category, given in parentheses.

TABLE IV-19
EXPECTED UMB EARTHQUAKE LOSSES, UMB PROGRAM ALTERNATIVES
Magnitude 8.3 Earthquake, Northern San Andreas Fault, 5:30 p.m.

Alternative	Property Losses in %[(a)]	Property Losses in $1,000	Deaths[(b)]	Hospital Injuries	Likely Demolished Sq.Ft.[(c)]	Likely Demolished (# Bldgs)
A- No Retrofit	42%	$1,197,000	1275	5100	18,480,000	(1068)
B- Voluntary	Not quantified but slightly less than Alternative A					
C- Wall anchors	33%	941,000	713	2852	5,810,000	(336)
D- 1988 L.A.	22%	643,000	190	758	1,680,000	(97)
E- Sec. 104(f)	18%	520,000	116	462	830,000	(48)

Source: Adapted from R & C 1990.

(a) Property loss expressed as a percentage of UMB stock replacement cost.

(b) Includes all UMB-related deaths, both inside and outside the buildings. The number of estimated deaths are thought to be accurate within a factor of 2 at the high end (large earthquake, large number of deaths) and within a factor of 4 at the low end (small earthquake, small number of deaths). However, relative relationships among the different alternatives are constant and valid for comparative purposes despite these ranges of uncertainty.

(c) The area of UMBs expected to receive damage greater than 40% of replacement cost (50% for strengthened buildings) and therefore considered likely to be demolished or non-functional for considerably longer than normal repair time. Dividing the area as given in square feet by the average UMB size yields a very rough estimate of the number of buildings in this category, given in parentheses.

G. ARCHITECTURAL AND HISTORIC RESOURCES

This discussion of potential impacts on architectural and historic resources is divided into three parts. The first subsection describes impacts resulting from building alterations that would be necessitated by certain construction activities required under the alternatives. The second part of the assessment addresses the potential for total loss of UMBs having architectural or historic merit due to decisions by owners to demolish and/or redevelop their properties instead of retrofitting. This type of potential impact is discussed in the second subsection, Program-induced Development. The third subsection, Earthquake Losses, discusses the building losses expected under the alternatives, specifically reductions in expected earthquake-caused building demolitions attributable to Alternatives C, D, and E.

1. RETROFIT CONSTRUCTION ACTIVITIES

Appendix D discusses the construction activities that would be used to accomplish the alternative levels of retrofit being considered. In addition, Table IV-2, page IV-11, provided an estimate of the percentage of UMBs that would utilize a particular construction activity under each alternative. Of the 22 activities, four could result in visible exterior alterations substantial enough to trigger Landmarks Preservation Advisory Board (LPAB) permit review, and possible City Planning Commission approval to minimize the level of visual intrusion. The four construction activities and the likely extent of their use by alternative are:

CONSTRUCTION ACTIVITY		APPROX. % OF UMBs REQUIRING ACTIVITY		
		ALTERNATIVE:		
NO.[a]	NAME	C	D	E
1	Tension Anchors	91%	91%	91%
6	Anchor Falling Hazards	18%	18%	18%
17	Infill openings	0%	3%	6%
19	Steel Diagonal Brace	0%	16%	41%

(a) Keyed to numbered discussion in Table IV-2 (Page IV-11) and R & C 1990.
Note: See text for a discussion of retrofits under Alternatives A and B.

a. Alternatives A and B. Retrofits under either of these alternatives would utilize construction activities similar to Alternative E, because they would be to the Section 104(f) level. For individual buildings, potential effects would be similar to those described later under Alternative E. However, relatively few buildings would retrofit under Alternative A or B (about 3% of UMBs), and permit review under existing Planning Code or Proposition M authority by the LPAB of those UMBs with architectural or historical merit would tend to minimize inappropriate retrofit designs. Use of the State Historic Building Code could permit flexibility in meeting the objectives of retrofit for eligible buildings while minimizing alterations that could adversely affect their architectural or historical character.

b. Alternative C. Compared with the other alternatives, Alternative C construction activities would have the least impact on the architectural resources of any given building although strengthening would be required of all UMBs. Of the four construction activities that could cause visible exterior alterations, Alternative C calls for two. Most (91%) of the buildings (under C or any of the alternatives) would require the addition of heavy-duty bolts (tension anchors). The least expensive bolting process extends the bolts entirely through the walls. The bolts with their plates would be visible at every floor level of a building, which could compromise the architectural integrity of some buildings.

Poorly anchored exterior architectural features can pose a serious falling hazard to people and property below. Alternative C provisions would require that such architectural ornamentation and facings be either anchored, replaced, or removed. (Hazardous adornments that are located at or near rooflines have already been (or shortly will be) required to be made safer in accordance with the existing parapet hazard abatement program.) It is estimated that about 18% of the UMBs would require this construction activity under Alternative C, D or E.

Removal of ornamentation would be the least expensive way to comply with a mandate to correct this hazard, but would also result in the greatest impact

to a building's architectural merit. Careful anchoring or replacement with similar looking modern materials could be performed but at greater expense. Review of proposed retrofit alterations of meritorious buildings by the LPAB would tend to minimize inappropriate retrofit designs. Completion of the UMB architectural survey as planned and recognition of any buildings of merit among the 322 UMBs for which no information is available would afford design protection to all such UMBs prior to any mandated retrofit work. Use of the State Historic Building Code could permit flexibility in meeting the objectives of retrofit for eligible buildings while minimizing alterations that could adversely affect their architectural or historical character. A local American Institute of Architects (AIA) committee is currently preparing design guidelines for retrofitting UMBs; such guidelines would provide clear standards for strengthening buildings while retaining architectural integrity.

c. Alternative D. In addition to the potential impacts described for Alternative C, some UMBs would be subject to additional work visible from the exterior under Alternative D. An estimated three percent of the UMBs are likely to have windows infilled as a relatively inexpensive means to achieve some of the Alternative D provisions. It is highly likely that this construction activity will be mostly reserved for use in industrial UMBs. For such UMBs with architectural merit, alternative means of complying with Alternative D's requirements are available, at greater expense.

The main activity differentiating this alternative from Alternative C is that roughly 16% of the UMBs would require installation of steel diagonal braces. When used, diagonal braces are usually placed on the inside face of exterior walls and some portion of the bracing could be visible through exterior windows.

Review of proposed retrofit alterations of meritorious buildings by the LPAB would tend to minimize inappropriate retrofit designs. Completion of the UMB architectural survey as planned and recognition of any buildings of merit among the 322 UMBs for which no information is available would afford design protection to all such UMBs prior to any mandated retrofit work. Use of the

State Historic Building Code could permit flexibility in meeting the objectives of retrofit for eligible buildings while minimizing alterations that could adversely affect their architectural or historical character. The AIA design guidelines for retrofitting UMBs (in preparation) would provide clear standards for strengthening buildings while retaining architectural integrity.

d. Alternative E. In addition to use of the same activities required by Alternative C, in the same proportion of buildings, Alternative E work would employ the infill of windows for approximately six percent of the UMBs--mostly for the one story and industrial group buildings. Diagonal bracing is estimated to be used by approximately 41% of the UMBs under Alternative E. As discussed above, such bracing may be visible through exterior windows. Review of proposed retrofit alterations of meritorious buildings by the LPAB would tend to minimize inappropriate retrofit designs. Completion of the UMB architectural survey as planned and recognition of any buildings of merit among the 322 UMBs for which no information is available would afford design protection to all such UMBs prior to any mandated retrofit work. As with the other alternatives, use of the State Historic Building Code could permit flexibility in meeting the objectives of retrofit for eligible buildings while minimizing alterations that could adversely affect their architectural or historical character. The AIA design guidelines for retrofitting UMBs (in preparation) would provide clear standards for strengthening buildings while retaining architectural integrity.

2. PROGRAM-INDUCED DEVELOPMENT

Certain program-induced building outcomes would affect architectural resources. Most obviously, rated UMBs that are potential candidates for either demolition/new construction or rendered "at risk" of ultimate demolition represent a potential loss of such resources.

Table IV-20, next page, summarizes the estimates of the approximate number of UMBs subject to these outcomes and identifies the current status of

TABLE IV-20

ESTIMATED UMB PROGRAM-INDUCED DEMOLITIONS BY ARCHITECTURAL/HISTORICAL PROTECTION STATUS[(a)]

Rating/Protection Category	Alter. C 2000	Alter. C 2020	Alter. D 2000	Alter. D 2020	Alter. E 2000	Alter. E 2020
	(Estimated Number of Demolitions)					
Year	2000	2020	2000	2020	2000	2020
Buildings surveyed; subject to automatic LPAB/CPC review[(b)]	17	12	54	42	157	134
Buildings surveyed; subject only to discretionary LPAB/CPC review[(c)]	28	18	76	60	210	185
Buildings not yet surveyed (9/90)	18	12	29	20	75	60
TOTALS	63	52	159	122	442	379

Source: San Francisco Department of City Planning and RHA 1990

(a) The 48 UMBs with institutional uses are not included in this assessment. These include a number of rated buildings. Institutions are generally not subject to purely economic development forces and are too individualistic to predict future outcomes of their buildings.

(b) Based on existing Planning Code or Proposition M authority: Comprises City Landmarks; buildings in adopted City Historic Districts; buildings designated Significant or Contributory in Area Plans of the Master Plan; Downtown buildings rated Category I, II, III or IV; Downtown buildings in Conservation Districts rated Category I, II, III, IV or V; buildings rated in the 1976 DCP Architectural Survey; buildings listed or declared eligible for National Register of Historic Places.

(c) Comprises buildings nominated for National Register of Historic Places; buildings in proposed City Historic Districts; buildings designated Not Significant or Contributory in Area Plans of the Master Plan; Downtown buildings rated Category V not in Conservation Districts; buildings rated by Heritage not otherwise protected.

Notes: Program-induced demolitions include demolitions for new construction plus buildings "at risk" of demolition. Most are in the "at-risk" category. The number of buildings in these categories attributable to the program alternatives decreases in the longer term (year 2020) compared with the shorter term (year 2000) because more of these building outcomes would have occurred by then in the base case (Alternative A), with or without a retrofit program.

LPAB = Landmarks Preservation Advisory Board
CPC = City Planning Commission

official protection of their architectural merit.

The Table includes only Alternatives C, D, and E because the effects of program-induced demolitions (both with new development and UMBs at risk of demolition) of UMBs resulting from Alternatives A or B are nominal and would be considered on a case-by-case basis, as warranted by specific circumstances.

Table IV-20 indicates that under Alternatives C, D, and E, respectively, increasing numbers of buildings considered to be architectural or historical resources would be at risk of demolition, in most cases due to insufficient value of the building relative to retrofit cost. In such cases, it could be possible for a building owner to demonstrate no remaining economic value in the building, which would allow demolition even under the most stringent current protections for designated buildings. While not quantifiable, it is considered probable that some architecturally and/or historically significant institutional buildings, particularly churches, would be at risk of demolition, particularly due to program costs under Alternatives D and E. It is assumed that some UMBs for which information about architectural merit is lacking would also be demolished, as shown in Table IV-20. This information would, however, be available before decisions on these UMBs are needed.

Certain other program-induced building outcomes, such as alterations and additions to the building, could also affect architectural resources. Such potential affects would be moderated by automatic or discretionary review of permit proposals by the LPAB and CPC, as described above for construction permits.

3. EARTHQUAKE LOSSES

Loss of significant buildings due to program-induced demolitions represents only part of the impact that a retrofit program would have on architectural and historic resources. Although increasing levels of strengthening would lead to progressively more buildings lost, such losses must be balanced against buildings "saved" from future earthquake destruction.

As discussed in more detail in the Geology/Earthquake Hazards Impacts section (IV.F.), engineering research estimates of UMB earthquake losses under Alternatives A, C, D, and E have been made specifically for the purpose of UMB alternatives analysis. These estimates were made both on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), and for scenario earthquakes of 7.0 on the northern Hayward Fault and 8.3 on the northern San Andreas Fault. The annual loss estimates provide the most rational method to factor in the uncertainties as to precisely when damaging earthquakes might occur. Expressing losses on an expected annual basis provides the statistical ability to determine how long it would probably take for the buildings saved by the various retrofit alternatives to equal and surpass the program-induced building losses. Expressing losses in a scenario, however, tends to be more understandable.

The engineering research work indicates that retrofit would "save" from earthquake loss, on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), roughly seven architecturally significant buildings annually under Alternative C, and nine under Alternatives D and E. When studied in comparison with the program-induced losses of buildings significant enough to warrant automatic LPAB review of alterations or demolitions as shown in Table IV-20, it can be seen that Alternative C strengthening would save from expected earthquake loss as many such buildings as it could lose to demolition in about two years. Under Alternative D, it would take about five-six years for such buildings saved from earthquake loss to balance those demolished due to program costs, and under Alternative E, it would take about 15-18 years.

In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, about 240 such buildings would be lost under Alternative A, 55 under Alternative C (= 185 buildings "saved"), 12 under Alternative D (= 225 "saved"), and 4 under Alternative E (= 235 "saved"). Given such an earthquake (considered the most likely scenario to occur over the next 30 years), Alternative C would provide a "net savings" (depending on when the earthquake might occur in relation to the shorter-term/longer-term program-induced

building losses) of about 170 significant buildings, Alternative D would provide a "net savings" of about 170-185 significant buildings, and Alternative E would provide a "net savings" of about 75-100 significant buildings.

NOTES - ENVIRONMENTAL IMPACTS

1. Rutherford & Chekene, "Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings," 1990. For San Francisco Department of City Planning.

2. Recht Hausrath & Associates, "Seismic Retrofitting Alternatives for San Francisco's Unreinforced Masonry Buildings: Socioeconomic and Land Use Implications of Alternative Requirements," 1990. For San Francisco Department of City Planning.

3. Relevant environmental documents, as follows:

Case No.	Title	Type	Date
81.3	Downtown Plan	EIR	Certified: 10/18/84
82.39	Rincon Hill Plan	EIR	Certified: 7/18/85
84.431	North of Market Special Residential District	Neg. Dec.	Approved: 2/21/85
85.463	South of Market Plan	EIR	Certified 12/7/89
86.505	Mission Bay	EIR	Draft 8/12/88
86.705	Chinatown Plan and Rezoning	Neg. Dec.	Approved: 2/11/87
87.586	Van Ness Avenue Plan and Rezoning	EIR	Certified 12/17/87

4. Department of City Planning staff, program notes from a workshop sponsored by Bay Area Regional Earthquake Preparedness Project (BAREPP), "The City of Los Angeles' Experience with Seismic Upgrading of UMBs and Its Application in San Francisco, " December 1989.

5. Martha Blair Tyler and Penelope Gregory of William Spangle and Associates, Inc., "Strengthening Unreinforced Masonry Buildings In Los Angeles: The Land Use and Occupancy Impact of L.A.'s Seismic Ordinance." Review Review Draft of February 1990.

6. Fred Herman, City of Palo Alto, telephone conversation with Alton Chinn, San Francisco Department of City Planning, October 29, 1990.

7. Mary C. Comerio, "Seismic Safety--At What Price?" Paper presented at a workshop sponsored by Bay Area Regional Earthquake Preparedness Project (BAREPP), "The City of Los Angeles' Experience with Seismic Upgrading of UMBs and Its Application in San Francisco, " December 1989.

8. DAHI summary, September 1988 reports an average of 14% vacancies in residential hotel SROs. The Golden Gate Hotel Assocation survey of March 1988 reports an average of 18% vacancies for that month among their membership residential hotels (approximately 60 hotels).

9. The Working Group on California Earthquake Probabilities, "Probabilities of Large Earthquakes Occurring in California on the San Andreas Fault." Unites States Geological Survey Open File Report 88-398 and Press Release of July 19, 1990--report forthcoming. Menlo Park, CA.

10. U.S. Geological Survey, Lessons Learned from the Loma Prieta, California, Earthquake of October 17, 1989, USGS Circular 1045, 1990.

11. Charles Scawthorn, Dames & Moore, Fire Following Earthquake, 1987. Prepared for the All-Industry Research Advisory Council.

12. Office of Emergency Services, Emergency Operations Plan, Volume I, 1989.

13. Andrew S. Lawson, et al., The California Earthquake of April 18, 1906: Report of the State Earthquake Investigation Commission, 2v and atlas, Carnegie Institution, Washington, D.C., 1908.

14. John A. Blume, San Francisco Seismic Safety Investigation, Geologic Evaluation, URS Associates, 1974.

15. A.W. Garcia and James R. Houston, Type 16 Flood Insurance Study, "Tsunami Predictions for Monterey and San Francisco Bays and Puget Sound," report prepared for the Federal Insurance Administration, U.S. Department of Housing and Urban Development, 1975.

16. J.R. Ritter and W.R. Dupre, Map showing potential inundation by tsunami in the San Francisco Bay Region, California, U.S. Geological Survey Miscellaneous Field Studies Map MF-480, 1972.

V. MITIGATION MEASURES

A. INTRODUCTION

The primary objective of the UMB program alternatives is to reduce life safety risks from earthquakes and related geologic hazards affecting these buildings. Therefore, the project itself is a mitigation measure for seismic hazards. Alternative A, while consisting of no new course of action, would result in some increase in life safety benefits due to market-induced (a) demolition of some UMBs and replacement with new buildings meeting the increased seismic resistance mandated by current building codes, and (b) conversion of some UMBs to more intensive uses with required retrofit to an Alternative E (Section 104(f)) level. It is estimated that about 6% of UMBs would be so affected within the next 10 years (1990-2000) and about 15% by the year 2020. Alternative B would probably achieve slightly higher life safety through incentives for upgrade.

The three mandatory strengthening alternatives C, D, and E would, in order, provide increasing life safety benefits, as detailed in the geology section of this EIR (Section IV.E.). These alternatives would also tend to reduce future expected earthquake damage to UMBs, resulting in lesser repair costs and fewer UMBs with damage sufficient to warrant demolition after earthquake events. Therefore, housing units, businesses, and other uses in UMBs would ultimately be conserved under these alternatives. These life safety and building conservation benefits would occur at the expense of some environmental impacts: displacement of existing residents and businesses in UMBs due both to short-term construction needs and longer-term economic impacts of retrofit costs; loss of existing (largely lower-rent) housing units and commercial space due to program-induced demolition or conversion of buildings containing housing; potential loss of buildings of architectural and/or historic merit due to retrofit costs; and construction-related dust and noise affecting building occupants. Alternatives C, D, and E would involve, in order, increasing levels of these impacts.

It must be emphasized that all of the above program-induced impacts would also occur in the event of an earthquake and subsequent UMB damage and repair or demolition. The post-earthquake impacts would be reduced under the three mandatory strengthening alternatives. Furthermore, a UMB program would provide the opportunity to plan for, control, and mitigate these impacts in a non-emergency situation, in contrast to a less controlled, emergency situation that would be generated by a substantial earthquake.

Two aspects of a UMB program that could mitigate both program impacts and earthquake hazard impacts under any of the mandatory strengthening alternatives are the timeframe for program compliance and priority of buildings to upgrade. Most program-induced impacts would be reduced with a longer timeframe for program and building compliance, because spreading out building upgrade over a longer time period would reduce the amount of dislocations of UMB residents and businesses occurring at any one time, allow for the more leisurely planning of UMB work and attendant disruptions, allow more time for UMB owners to seek financial and other forms of assistance to pay for retrofit, and reduce the overall extent of change and impact at any given time. To the extent program compliance is extended, the primary program objective of life safety is compromised, because the likelihood of a damaging earthquake increases in proportion to the timeframe considered. For example, a given earthquake is six times as likely to occur during a 30-year time interval than a five-year interval. Thus, a program under which buildings would not all be retrofitted for 30 years is much more likely to result in greater earthquake-caused impacts, particularly casualties and damage.

Because of the "guessing game" implied above as to when a damaging earthquake might occur, program objectives would be better achieved the earlier all UMBs are strengthened. However, a very rapid program timeframe (say, five years or less to strengthen all UMBs) would exacerbate impacts and would be particularly disruptive due to possible program-generated shortages of temporary space for UMB residents and businesses during construction. The UMB program ultimately selected should optimize the compliance timeframe to

require strengthening of buildings as quickly as possible without generating substantial impacts.

The second aspect of any mandatory UMB program affecting program objectives and impacts is the priority system chosen. The UMB database has been developed to permit testing of the effect various priority schemes would have on expected resultant life safety and damage due to geologic and technical factors such as soils and building characteristics, as well as other factors such as building and adjacent outdoor occupancy levels. It is therefore possible to determine which categories or geographic areas of buildings should be strengthened earliest in order to maximize the probability that the buildings posing the most risk are retrofitted prior to a damaging earthquake.

A third major form of mitigation would be some kind of financial assistance for the cost of retrofit. To the extent the cost burden on UMB owners is reduced, the number of buildings at risk of demolition or conversion would be reduced, which in turn would reduce the potential program-generated loss of dwelling units, commercial space, and historic buildings. Such assistance would be particularly important in reducing the significant program impacts of Alternative E, and the lesser but still noteworthy effects of Alternative D.

The remainder of this section will discuss potential mitigation measures for the various environmental impacts noted in the Impacts section of this EIR. Significant impacts which cannot be effectively mitigated are presented in Section VI.

B. RETROFIT CONSTRUCTION IMPACTS

1. Displacement

Temporary displacement of UMB residents and businesses during construction under Alternatives D and E is, to some extent, unavoidable.

However, if residents and businesses are willing and able to put up with noise, dust, utility interruptions, and other construction-related disruptions, much retrofit under Alternative D and some under Alternative E could occur with occupants in place. Therefore, despite the assumption in the EIR analysis that about one-third of UMBs under Alternative D and one-half under Alternative E would be vacated for construction, it is possible that those persons and businesses which would be most adversely affected by temporary relocation (or, in the case of some businesses, closure) could choose to remain during construction.

To lessen the adverse effect of residential displacement, the UMB program should avoid citing for retrofit work a large number of dwelling units at once. One method would be to carefully specify a relatively even distribution of compliance notices over time, particularly for UMBs containing a large number of residential units, namely Prototypes C and N. These two building types comprise 15% of the total UMBs but contain almost 62% of the affected residential units (split almost evenly between apartments and single room occupancy units). Because of their large size it is not expected that these building types would be totally emptied during the retrofit work no matter which level of strengthening (if any) is mandated. The vast majority of the units contained in prototypes C and N are located in the North of Market/Civic Center area with the balance distributed mainly in the Bush Street corridor area, Downtown and Chinatown.

Citations for mandatory retrofit work should be planned with consideration of availability of relocation dwelling units and commercial space in mind, and to avoid unnecessary geographic concentrations of relocation needs at any one time. Through careful planning, the program could help maximize availability of retrofitted dwelling units and commercial space returning to the market in the same areas and at the times relocation units are needed for buildings yet to be retrofitted.

If a mandatory UMB program is recommended, the UMB Task Force is expected to include, as part of such a program, preparation of a standard Seismic

Retrofit Inconvenience Plan agreement through the Residential Rent Stabilization and Arbitration Board (Rent Board) to address issues important to both tenants and landlords, including temporary relocations.

2. Dust, noise, and other direct construction impacts

The standard Seismic Retrofit Inconvenience Plan agreement should include issues of habitability such as dust, noise, loss of privacy, and other impacts and inconveniences of construction. The Plan, at minimum, should specifically include mitigation measures such as:

- Clear, multilingual advance notice to tenants of the scope of construction work, anticipated beginning and end dates, extent of inconvenience, steps tenants can take to cooperate or reduce their own inconvenience;
- Written advance notice of all worker entry and disruptions of services;
- Limitations on hours of construction to avoid evening and nighttime noise impacts;
- Providing dust barriers as needed to reduce dust transmission;
- Commitment to avoid unsafe or hazardous conditions at all times;
- Daily removal of debris and vacuuming of common areas and occupied dwelling units;
- Vermin/pest control as warranted by conditions;
- Assurance of alternative services (bottled water, microwave oven in a common area, space heaters, etc.) at all times in the event of interruption of normal utilities and services.

Guidance for building owners concerning construction, dislocation, and other retrofit issues should be incorporated into a Building Owners Handbook, to be prepared under the UMB program and made available to all UMB owners. The Handbook would provide, in one reference, information and sources of assistance concerning all aspects of seismic retrofit.

C. PROGRAM-INDUCED DEVELOPMENT IMPACTS

Essentially because of their increasing costs, Alternatives C, D, and E would involve, in order, increasing levels of impacts which would be indirectly induced by a mandatory strengthening UMB program. These impacts are: displacement of existing residents and businesses in UMBs and loss of existing (largely lower-rent) housing units and commercial space due to program-induced demolition or conversion of buildings containing housing; and potential loss of buildings of architectural and/or historic merit due to program-induced demolition. Because of the mitigative aspects of a mandatory UMB program, discussed earlier in this section and detailed in Section IV.D. (Growth Inducing Impacts), some new construction would occur on UMB sites to replace dwelling units and commercial space lost. However, the existing, low-rent nature of this space is not likely to be duplicated. Similarly, a mandatory strengthening program would ultimately save more architecturally and historically significant UMBs in the event of damaging earthquakes than would be lost to program-induced demolition. However, program-induced losses of historic buildings would nonetheless be expected, particularly under Alternative E.

Such impacts would result from likely building outcomes given the financial burden of mandatory retrofit. While numerous existing regulations and policies are protective of existing buildings, housing units, and historic resources, even the most stringent protections allow exceptions due to extreme financial burdens. For example, Downtown Significant Buildings, normally not permitted to be demolished, may be approved for demolition if the property retains no substantial remaining market value or reasonable use taking into account the cost of rehabilitation to meet Building Code requirements.

Therefore, while impacts would be greater absent existing protective regulations and policies, further reduction of impacts could be achieved only through some means of financial assistance for retrofit of the buildings at risk of demolition. At the present time, available assistance is small in relation to the total costs, and it can not be assumed that substantial funding in the future would be available. Should such funding become available and targetted toward those buildings with housing, commercial space, or architectural resources most in need of assistance, program-induced impacts would be proportionately reduced.

In the absence of financial assistance, consideration could be given to providing exemptions, appeals, and/or the ability to retrofit to lesser standards buildings of particular merit which lack the financial capability to carry out retrofit work. Such mitigations would, however, provide lesser seismic life safety and could increase the risk of eventual building loss anyway in the event of an earthquake. To reduce these risks, it could in some cases be feasible to require reduced occupancy loads or times of occupancy for certain buildings. For example, rather than force an historic church to demolish due to lack of resources to retrofit, a requirement of limiting occupancy to just a few hours per week might be imposed. Such flexibility could provide some measure of improved safety while avoiding some of the most severe potential program-induced building losses.

VI. SIGNIFICANT ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED IF THE PROPOSAL IS IMPLEMENTED

This chapter is subject to final determination by the City Planning Commission as part of its certification process for the EIR. Chapter VI of the Final EIR will be revised, if necessary, to reflect the findings of the Commission.

This chapter presents significant effects of the various alternatives assuming that mitigation of financial assistance to building owners is not available. If such assistance should become available, the expected number of program-caused demolitions would be reduced, thus enabling higher levels of strengthening with lesser program impacts.

The life safety implications of each alternative are presented in this section, because there is no basis upon which to determine acceptable levels of risk to human life in an EIR. Since there is no basis to include, exclude, or characterize these life safety implications, they are presented for each alternative so that the public and decision-makers may judge their relative importance.

The trade-offs each alternative involves between expected building and human losses due to program costs versus loss reduction due to increased earthquake resistance are discussed in the Impacts section, particularly in the Displacement section (IV.E.) and the Architectural Resources section (IV.G.), as well as the introduction to the Mitigation section (V.)

Alternative A (No Program):

No earthquake casualty or damage reduction beyond that which would occur due to ongoing UMB retrofit or demolition/replacement with new construction due to market forces.

Annual expected deaths in UMBs: 12.6. Annual expected hospital injuries: 50.2. Annual expected building losses: 24 UMBs. Expected losses in UMBs in a magnitude 7.0 earthquake, Hayward Fault, 3:00 p.m.: 438 deaths, 1751 hospital injuries, 534 UMBs likely to be destroyed or demolished. Expected losses in UMBs in a magnitude 8.3 earthquake, San Andreas Fault, 5:30 p.m.: 1275 deaths, 5100 hospital injuries, 1068 UMBs likely to be destroyed or demolished.

In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, about 3170 residential units would be lost under Alternative A, and about 1445 businesses would be displaced. About 240 architecturally significant buildings would be sufficiently damaged to warrant demolition.

<u>Alternative B</u> (Voluntary Program):

Impacts similar to Alternative A, slightly fewer casualties, buildings destroyed or demolished, and significant buildings lost due to earthquakes.

<u>Alternative C</u> (Wall Anchors and Interconnection):

Compared with Alternative A, about one-half the expected earthquake casualties and roughly one-quarter the buildings lost.

Annual expected deaths in UMBs: 6.0. Annual expected hospital injuries: 23.9. Annual expected building losses: 7 UMBs. Expected losses in UMBs in a magnitude 7.0 earthquake, Hayward Fault, 3:00 p.m.: 203 deaths, 813 hospital injuries, 111 UMBs likely to be destroyed or demolished. Expected losses in UMBs in a magnitude 8.3 earthquake, San Andreas Fault, 5:30 p.m.: 713 deaths, 2852 hospital injuries, 336 UMBs likely to be destroyed or demolished.

Retrofit would "save" from earthquake loss, on a statistically expected <u>annual</u> basis (considering probabilities of all earthquakes from all faults

affecting San Francisco), 112 residential units and building space containing 44 businesses annually under Alternative C. In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, about 3170 residential units would be lost under Alternative A, about 480 residential units would be lost under Alternative C (= 2690 units "saved" compared with Alternative A), and about 330 businesses would be displaced (= 1115 businesses "saved" from displacement compared with Alternative A).

Alternative D (UCBC Draft 7, similar to L.A. practice):

Compared with Alternative A, roughly one-seventh the expected earthquake casualties and roughly one-tenth the buildings lost.

Annual expected deaths in UMBs: 1.7. Annual expected hospital injuries: 6.8. Annual expected building losses: 3 UMBs. Expected losses in UMBs in a magnitude 7.0 earthquake, Hayward Fault, 3:00 p.m.: 44 deaths, 177 hospital injuries, 25 UMBs likely to be destroyed or demolished. Expected losses in UMBs in a magnitude 8.3 earthquake, San Andreas Fault, 5:30 p.m.: 190 deaths, 758 hospital injuries, 97 UMBs likely to be destroyed or demolished.

Retrofit would "save" from earthquake loss, on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), 139 residential units annually under Alternative D. In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, about 3170 residential units would be lost under Alternative A, 155 under Alternative D (= 3015 "saved").

Retrofit would "save" from earthquake loss, on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), building space containing 56 businesses annually under Alternative D. In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, space containing about 1445 businesses would be lost under Alternative A, 70 under Alternative D (= 1375 "saved").

Although strengthening UMBs to Alternative D level would save more significant buildings in the long term than would be lost due to program costs, about 55-60 UMBs officially recognized as having architectural or historical merit would be at risk of demolition, possibly including historic church buildings. If a damaging earthquake should not occur for a considerably longer period of time than the length of the retrofit program, these buildings would represent a notable loss.

Retrofit would "save" from earthquake loss, on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), roughly nine architecturally significant buildings annually. In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, about 20 such buildings would be lost, representing 170-185 buildings "saved" compared with Alternative A.

Alternative E (Section 104(f), S.F. Building Code):

Compared with Alternative A, roughly one-twelfth the expected earthquake casualties and roughly one-twentieth the buildings lost.

Annual expected deaths in UMBs: 1.1. Annual expected hospital injuries: 4.2. Annual expected building losses: 2 UMBs. Expected losses in UMBs in a magnitude 7.0 earthquake, Hayward Fault, 3:00 p.m.: 23 deaths, 92 hospital injuries, 9 UMBs likely to be destroyed or demolished. Expected losses in UMBs in a magnitude 8.3 earthquake, San Andreas Fault, 5:30 p.m.: 116 deaths, 462 hospital injuries, 48 UMBs likely to be destroyed or demolished.

Temporary displacement of occupants of approximately 33% of residential UMB units due to construction, possibly leading to permanent displacement.

About 28% of UMBs, containing 20% of commercial space (4 million square feet) and 57% of dwelling units (about 12,400) in UMBs would be potentially lost due to program-induced demolition or conversion of use.

Retrofit would "save" from earthquake loss, on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), 148 residential units annually under Alternative E. In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, about 3170 residential units would be lost under Alternative A, 50 under Alternative E (= 3120 "saved").

Retrofit would "save" from earthquake loss, on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), building space containing 59 businesses annually under Alternative E. In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, space containing about 1445 businesses would be lost under Alternative A, 30 under Alternative E (= 1415 "saved").

Although strengthening UMBs to Alternative D level would save more significant buildings in the long term than would be lost due to program costs, about 170 UMBs officially recognized as having architectural or historical merit would be at risk of demolition, possibly including historic church buildings. If a damaging earthquake should not occur for a considerably longer period of time than the length of the retrofit program, these buildings would represent a notable loss.

Retrofit would "save" from earthquake loss, on a statistically expected annual basis (considering probabilities of all earthquakes from all faults affecting San Francisco), roughly nine architecturally significant buildings annually. In a Magnitude 7.0 earthquake on the Hayward Fault near San Francisco, about seven such buildings would be lost, representing 75-100 buildings "saved" compared with Alternative A.

VII. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

As discussed in Section V (pages V-1 et. seq.), the three mandatory strengthening alternatives C, D, and E would, in order, provide increasing long term life safety benefits and would also tend to reduce long term future expected earthquake damage to UMBs, resulting in lesser repair costs and fewer UMBs with damage sufficient to warrant demolition after earthquake events. Therefore, housing units, businesses, and other uses in UMBs would ultimately be conserved under these alternatives. These life safety and building conservation benefits would occur at the expense of some shorter term environmental impacts: cumulative displacement of existing residents and businesses in UMBs due both to short-term construction needs and longer-term economic impacts of retrofit costs; cumulative loss of existing (largely lower-rent) housing units and commercial space due to program-induced demolition or conversion of buildings containing housing; potential loss of buildings of architectural and/or historic merit due to retrofit costs; and construction-related dust and noise affecting building occupants. Alternatives C, D, and E would involve, in order, increasing levels of these impacts.

A UMB program would involve these short term impacts, balanced against the long term benefit of rehabilitation, increased safety to occupants and passersby, and increased longevity of this aging building stock.

The City believes adoption of a UMB program is justified now, rather than reserving an option for future alternatives, because of the immediate earthquake hazard as evidenced by increasing seismicity in the Bay region and the Loma Prieta earthquake of 1989. The options being considered reflect current knowledge of how to strengthen older buildings. The City is unaware of any potential imminent knowledge breakthrough that would achieve the project objectives without associated impacts.

VIII. SIGNIFICANT IRREVERSIBLE ENVIRONMENTAL CHANGES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

None of the alternatives would generate significant land use changes utilizing significant amounts of non-renewable resources. Construction materials needed for retrofit work are available in the amounts which would be required.

Alternative E could lead to the loss of more dwelling units in UMBs than its strengthening level would save from earthquake losses, as discussed in Section IV.E.2. Alternative A, "no project," would lead to the most casualties, building damage and losses, and disruption in the event of earthquakes. Implementation of Alternatives C, D and E, in order, would increasingly save potential earthquake casualties, reduce building damage and losses, and reduce disruption due to earthquakes. Some degree of earthquake casualties, building damage, and disruption would occur under any of the alternatives. It is not possible to establish a firm threshold of human life losses which can be generally agreed upon as "significant" or "not significant." Furthermore, the magnitude of these and other program effects depends in large part upon the program timeframes and priority schemes chosen. Therefore the information in Section IV (Impacts) and Sections VI (discussing unavoidable adverse impacts) and VII (discussing short-term and long-term impact relationships) should be used as input toward establishing a consensus of appropriate levels of building safety consistent with minimization of program-generated hardship and disruption.

IX. EIR AUTHORS, ORGANIZATIONS AND PERSONS CONSULTED

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X. EIR DISTRIBUTION LIST

The Draft Environmental Impact Report was sent to members of the Board of Supervisors, City Planning Commission, Landmarks Preservation Advisory Board, Seismic Investigation and Hazards Survey Advisory Committee, the UMB Task Force, and the UMB Citizens Advisory Committee.

San Francisco Main Public Library and all City Library branches were sent copies of the Draft EIR.

Notices of availability of the Draft EIR were sent to all UMB owners of record (approximately 2,000), and a UMB mailing list of interested parties consisting of approximately 500. In addition, a notice of availability was sent to parties on the City's standard EIR distribution list.

The complete Draft EIR distribution list is available for inspection at the Department of City Planning, 450 McAllister Street, 4th Floor Reception, and at the Office of Environmental Review, 6th Floor.

APPENDIX A

Initial Study

City and County of San Francisco
Department of City Planning

450 McAllister Street
San Francisco, CA 94102

NOTICE THAT AN
ENVIRONMENTAL IMPACT REPORT
IS DETERMINED TO BE REQUIRED

Date of this Notice: December 1, 1989

Lead Agency: City and County of San Francisco, Department of City Planning
450 McAllister Street - 6th Floor, San Francisco, CA 94102
Agency Contact Person: Paul Deutsch Telephone: (415) 558-6383

Project Title: Earthquake Hazard Reduction in Unreinforced Masonry Buildings (UMB): Program Alternatives
Project Sponsor: Chief Administrative Officer
Project Contact Person: David Prowler (558-6280)

Project Address: Approximately 2,000 buildings that are located throughout the City with concentrations in the area bordered by Broadway on the north, Van Ness on the west, Highway 101 and Townsend on the south and the Embarcadero on the east.

City and County: San Francisco

Project Description: The City is considering several program alternatives to address the hazards to life and safety posed by the 2000 privately-owned unreinforced masonry buildings (UMBs) in the event of a large earthquake. The City's goal is to determine whether it can develop and implement a program that would increase life safety (by making UMBs more resistant to seismic damage) without causing unreasonable difficulty to the owners, occupants and other users of these buildings.

THIS PROJECT MAY HAVE A SIGNIFICANT EFFECT ON THE ENVIRONMENT AND AN ENVIRONMENTAL IMPACT REPORT IS REQUIRED. This determination is based upon the criteria of the Guidelines of the State Secretary for Resources, Sections 15063 (Initial Study), 15064 (Determining Significant Effect), and 15065 (Mandatory Findings of Significance), in addition to the following reasons, as documented in the Environmental Evaluation (Initial Study) for the project. The potentially significant environmental effects of at least some of the alternatives under consideration, or the alternatives in conjuction with cumultive impacts of other projects in the vicinity of UMB concentration areas include impacts on the following resources: land use; population distribution (through displacement) and housing; employment; geologic hazards; historic buildings; health hazards; established educational or religious uses; and fire and emergeney services. Depending on the EIR assessment's findings, localized development and population growth inducement may also impact air quality, transportation, archaelogical resources and urban design resources.

Deadline for Filing of an Appeal of this Determination to the City Planning Commission: December 11, 1989.

An appeal requires: 1) a letter specifying the grounds for the appeal, and;
2) a $75.00 filing fee.

Barbara W. Sahm

BARBARA W. SAHM
Environmental Review Officer

BWS:JRH:rlj:24

ENVIRONMENTAL EVALUATION CHECKLIST
(Initial Study)

File No. 89.122 E

Title: Earthquake Hazard Reduction in Unreinforced Masonry Buildings (UMB): Program Alternaives

Street Address: Throughout the City with concentration in the area generally bounded by Van Ness Avenue, Broadway, the Embarcadero, (U.S. 101) Townsend Street and the Central Skyway.

Assessor's Block/Lot: Approximately 2,000 lots on approximately 500 blocks would be affected.

Initial Study Prepared by: Janice R. Hutton

I. PROJECT DESCRIPTION

A. INTRODUCTION

The City of San Francisco is in the process of considering alternative programs to reduce the earthquake-related life safety hazard posed by the approximately 2000 privately-owned unreinforced masonry buildings (UMBs) that are located in the City. The San Francisco UMBs are brick buildings that were built before 1952, most before 1924. The City's goal is to define a program that would increase life safety (such as by making UMBs more resistant to earthquake damage) without causing unreasonable demands (in terms of cost and disruotion) on the owners, occupants and other users of these buildings.

B. BACKGROUND

In 1988, a United States Geological Survey working group estimated that there is a 50% probability that a major earthquake--larger than Richter Magnitude (R) 7.0--will occur on the northern San Andreas or Hayward fault during the next 30 years--before the year 2018. There is also a 20% probability that a R 7.0 earthquake will occur in the San Francisco Bay area within the next 10 years--by the year 1998./1/ Initial expert opinion indictes that the occurrence of the Loma Prieta earthquake of October 1989 has not altered these estimates.

In an earthquake, deaths and major injuries are caused primarily from the complete or partial failure of existing structures, including buildings that are vulnerable to earthquake forces. UMBs in particular have performed poorly in every damaging California earthquake and, although not all UMBs will collapse in a significant earthquake, a large number of them will have some degree of life-threatening failure,/2/ due either to partial or total collapse or to brick walls falling out onto open spaces which represents a significant risk to pedestrian and vehicular traffic.

/1/ The Working Group on California Earthquake Probabilities, Probabilities of Large Earthquakes Occurring in California on the San Andreas Fault, 1988. United States Geological Survey Open File Report 88-398. Menlo Park, CA.

/2/ California Seismic Safety Commission, Guidebook to Identify and Mitigate Seismic Hazards in Buildings, 1987. Report No. SSC 87-03. Sacramento, CA.

Recognizing both the impending earthquake threat and the danger posed by unreinforced masonry buildings, the Mayor of City of San Francisco directed the Chief Administrative Officer (CAO) to recommend a program to improve the earthquake safety of the privately owned UMBs in San Francisco. In addition, the City's Bureau of Building Inspection (BBI) identified a working list of approximately 2000 UMBs and, in 1987, notified the building owners that their buildings were considered to be of unreinforced masonry construction.

In recognition of the UMB hazard and in accordance with recommendations by the City's UMB Task Force and Citizens' Advisory Committee, the CAO requested the Department of City Planning (DCP) to study the social, economic and environmental impacts of a possible City requirement to upgrade the ability of UMBs to withstand earthquake-related ground shaking.

DESCRIPTION OF THE BUILDINGS AND THEIR LOCATION

This population of UMBs is located primarily in the northeast portion of City with approximately 90% being concentrated in Downtown, Chinatown, the Tenderloin (North of Market), the Bush Street corridor (including Pine and Sutter Streets), the Civic Center area, South of Market, and the inner Mission area. The map on page 3 indicates the general distribution of the UMBs. Twenty-five percent of the UMBs are confined to only 24 blocks and 50% are located on 73 blocks.

The UMB building stock is predominantly low rise, with about 68% being three stories or less, and almost all (97.5%) six stories or less. Twenty percent of the UMBs are 5,000 square feet or less and about half are 10,000 square feet or less. Less than six percent are over 50,000 square feet in size.

An initial review of available information indicates that the UMBs primarily contain residential and commercial uses, as summarized below:

Primary Use	Approximate Percent of UMB Population
Residential [a]	40
Commercial	30
Industrial	15
Office	10
Assembly and others	5

a. Including mixed use but predominately residential.

The range of uses is very wide, including Pacific Heights mansions, churches and private schools. The residential units are dominated by approximately 21,500 relatively low cost small apartment or single room occupancy units. Another 5,500 or so are tourist hotel units. A precise estimate of the number

General Distribution Of UMBs In San Francisco

1 Downtown (343 UMBs)
2 South of Market (194 UMBs)
3 South of Market Residential (114 UMBs)
4 North of Market / Civic Center (312 UMBs)
5 Bush Street Corridor (196 UMBs)
6 Van Ness / Polk (99 UMBs)
7 Chinatown (293 UMBs)
8 North Beach (50 UMBs)
9 Waterfront (36 UMBs)
10 Mission / Upper Market (136 UMBs)
11 Outlying (234 UMBs)

UMB Study 10-16-89

of jobs located in these buildings is not available at this time though indications are that a minimum of 3500 businesses are directly housed in the UMBs. The population exposed to death and injury from earthquake-related UMB damage is comprised not only of permanent residents and employees in UMBs but also of thousands of other San Francisco residents and visitors who are exposed to the hazard through daily activiites of working, shopping, eating out, going to church, theatres or other places of entertainment.

C. PROJECT CHARACTERISTICS

The environmental impact report (EIR) will analyze the direct and indirect impacts of five basic alternatives that are briefly summarized below. Alternatives C, D and E, respectively represent increasing levels of required structural resistance to seismic forces. For each type of UMB (e.g.large versus small buildings) the EIR will describe in detail the types of work and impacts that would be involved in achieving each of these three levels of seismic force resistance.

Alternative A: No Project. Under this alternative, existing programs to increase life safety and upgrade emergency response would continue at their present level and pace. These efforts include: enforcement of the Citywide building parapet bracing (or removal) program; required seismic strengthening of buildings proposed to undergo substantive expansion of intensification of use (Section 104(f) of the San Francisco Building Code); the Seismic Safety Program (an effort to reduce earthquake vulnerability in City-owned buildings); and emergency preparedness efforts by the Mayor's Office of Emergency Services, the Fire Department and other departments. In addition, the Bureau of Building Inspection would maintain for public inspection its working list of the identified UMBs;

Alternative B: Voluntary Program. Under this alternative, resources would be provided to develop a program to encourage voluntary upgrade, possibly including (for example) an informational program and an owner duty to inform building occupants and prospective buyers of the building's condition. An owner may also be required to submit an engineer's strengthening plan to include a cost estimate so that a prospective UMB buyer would be alerted;

Alternative C: Anchorage and Interconnection. This alternative would require UMB owners to anchor and interconnect all parts of their buildings, based on plans submitted to and approved by the City. The plans would be designed so that anchorage of masonry walls to each adjacent wall, floor and roof would resist a minimum specified seismic force level. This alternative has sometimes been referred to in the literature as "bolts only";

Alternative D: Model Ordinance. This alternative would require that UMBs be strengthened to a level in accordance with the forthcoming California Seismic Safety Commission's model ordinance that is being finalized by the Structural Engineers Association of California. The model ordinance is similar to the City of Los Angeles' existing UMB strengthening ordinance, but improves upon it based on experience gained in L.A. including the UMB performance in the recent earthquakes; and

Alternative E: Section 104(f). This alternative would require that UMBs be strengthened to a level in accordance with existing Section 104(f) of the San Francisco Building Code (now required only of buildings proposed by an owner for expansion or intensification of use). This requirement is equivalent to the 1973 Uniform Building Code.

Variation in ordinance compliance periods will be evaluated in the EIR for Alternatives C, D and E. The program to complete strengthening of the approximately 2000 UMBs may vary from 5 to 30 years. Notices to comply with the ordinance would be issued serially to groups of owners who may then have 1 to 2 years within which to comply. The order in which buildings are selected to comply may be based on a hazard index (that considers building occupancy and type of use) or some other characteristic such as location, type of use, pedestrian exposure to hazard or building size.

In addition to this range of alternative approaches to upgrading the seismic resistance of the UMBs, the City's Chief Administrative Officer, in consultation with the UMB Task Force and Community Advisory Committee will be recommending a program of financial and other assistance to owners and occupants of the UMBs. This program will consider topics such as whether and to what extent the City can assist UMB owners and occupants with both the direct costs of strengthening the UMBs and the related indirect costs (e.,g., temporary or permanent relocation, including costs of lost revenues). This public assistance may include City provision of centralized services, such as technical assistance (e.g., in occupant relocation management or in form filing for selected tax credits) or financial assistance (e.g., through low interest, long-term loans from bond sale revenue or other sources). These recommendations will also be discussed in the EIR and the extent they may alter the type or intensity of impacts will be assessed.

Among the numerous sources of information and data that will be utilized in EIR preparation will be that available from relevant past earthquakes, including the recent Loma Prieta earthquake and the experiences of other jurisdictions in implementing UMB retrofit ordinances with particular reference to that of the City of Los Angeles.

A separate socio-economic report will analyze financial and social implications of both Building Code and public assistance alternatives, while the EIR will focus on potential impacts on the physical environment. The socio-economic study and Draft EIR are scheduled to be released in May 1990. A public comment period of about 45 days, including a public hearing before the City Planning Commission, will provide the opportunity for interested individuals and groups to comment on the Draft EIR. All comments will be responded to in a Final EIR, which must be certified as complete and accurate by the City Planning Commission. The Chief Administrative Officer (CAO) will then recommend a program, if any, to the Board of Supervisors, based on Community Advisory Committee and UMB Task Force recommendations. The ultimate decision will be made by the Board of Supervisors following additional public hearings. Board action is expected by the end of 1990.

II. SUMMARY OF PROJECT EFFECTS

The range of alternatives as described above is examined in this Initial Study to identify potential impacts on the environment.

A. SIGNIFICANT EFFECTS

Based on an assessment of impacts, it was determined that the potentially significant environmental effects of at least some of the alternatives under consideration, or the alternatives in conjunction with cumulative impacts of other projects in the vicinity of UMB concentration areas include impacts on the following resources: land use; population distribution (through displacement) and housing; employment; geologic hazards; historic buildings; health hazards; established educational or religious uses; and fire and emergency services. Depending on the EIR assessment's findings, localized development and population growth inducement may also impact air quality, transportation, archaeological and urban design resources.

B. INSIGNIFICANT EFFECTS

Topics for which effects were determined to be insignificant require no further investigation and will not be discussed in the EIR. These topics and reasons for their elimination from further assessment are summarized below and discussed in greater detail in Section III.

Utilities/Public Services: Given recently adopted and proposed zoning limitations in the areas where most UMBs are located and restrictions on changes in residential uses, notable shifts in land uses are not expected to result from adoption of a UMB program. Consequently, major changes in demands on public utilities, facilities and most public services are not expected. One possible exception that will be explored in the assessment is a potential increase in the number of homeless persons leading to an increase in demand for private and public services to homeless people.

Biology: The potentially affected building stock is located in areas that have been developed and urbanized for decades. Consequently, none of the alternatives could cause a major impact on existing vegetation or wildlife or affect any threatened, endangered or other sensitive plant or animal species.

Water: The project would not have an effect upon public water supplies or storm-water run-off.

Energy: For most affected UMBs, the activities involved with strengthening a building would be similar to an interior remodeling project. Energy use attendant to such work is nominal. Since major changes in uses are not expected to be promoted by a UMB program, a notable change in long term energy use rates is not expected.

Hazards: Hazards associated with earthquake effects will be assessed in detail with particular emphasis on UMB damage and losses for the alternative programs. Possible health effects related to continued building occupancy during UMB strengthening activities will also be addressed in the EIR.

Increased human exposure to other hazards, including hazardous or toxic wastes in soils, is not expected to be promoted through implementation of any of the program alternatives because surface disturbing activities are not necessary in order to strengthen UMBs.

III. ENVIRONMENTAL EVALUATION CHECKLIST

A. COMPATIBILITY WITH EXISTING ZONING AND PLANS	Not Applicable	Discussed
1) Discuss any variances, special authorizations, or changes proposed to the City Planning Code or Zoning Map, if applicable.	___	X
*2) Discuss any conflicts with any adopted environmental plans and goals of the City or Region, if applicable.	___	X

Overall, the project would not appear to conflict with environmental plans or goals of the City or region. The relationship of the alternatives to the objectives and policies of the San Francisco Master Plan will be addressed under the relevant impact topics in the EIR. The UMB program alternatives would be subject to review and adoption by the Board of Supervisors and, depending on which alternative is adopted, concomitant program elements may also necessitate amendments to the San Francisco Building Code, and possibly others (i.e., the Planning Code, Rent Stabilization Ordinance, etc.).

Prior to taking action on adoption of any alternative program elements or their implementing legislation, the Board of Supervisors would also have to review the program in light of the eight priority policies mandated by Proposition M, which was approved by the voters of San Francisco in November 1986. These policies are: the preservation and enhancement of neighborhood-serving retail uses; the protection of neighborhood character; preservation and enhancement of affordable housing; discouragement of commuter automobiles; protection of industrial and service land uses from commercial office development and enhancement of resident employment and business ownership; earthquake preparedness; landmark and historic building preservation; and protection of open space.

B. ENVIRONMENTAL EFFECTS

1) Land Use - Could the project:	YES	NO	DISCUSSED
*(a) Disrupt or divide the physical arrangement of an established community?	X	___	X
(b) Have any substantial impact upon the existing character of the vicinity?	X	___	X

The EIR will examine the extent to which changes in land uses would be induced by a requirement that UMBs be structurally strengthened to increase life safety in a large earthquake.

Three-quarters of the UMBs are located in plan areas that have been recently downzoned and have strict housing preservation/conservation provisions. The plan areas involved are Chinatown, Downtown, North of Market, Van Ness Corridor and the interim zoning controls for South for Market. Given current zoning in these areas where UMBs are concentrated, substantial changes in types of land uses are not anticipated.

Current land use regulations notwithstanding, the retrofit compliance periods being considered in the UMB studies range from five to thirty years. Over a thirty year period, the mix of land uses and development intensity in a given area are subject to considerable change depending on both real estate market demands and community values as reflected in regulatory constraints. Imposition of requirements on UMB owners, with associated costs, could serve to alter ongoing trends in land use. These topics will be assessed by geographic area to the extent that trends in land use and development intensity are reasonably foreseeable. The level of impact significance will be established based on estimations of population displacement, extent of change in community character and the potential for growth inducing effects in some locales.

2) <u>Visual Quality</u> - Could the project:	YES	NO	DISCUSSED
*(a) Have a substantial, demonstrable negative aesthetic effect?	X		X
(b) Substantially degrade or obstruct any scenic view or vista now observed from public areas?		X	X
(c) Generate obtrusive light or glare substantially impacting other properties?		X	X

<u>Urban Design, Open Space, Wind and Shadow</u>

The UMBs are located in areas where the topography varies from generally flat to moderately sloping. Existing wind conditions in most of these areas are calmer relative to other areas of San Francisco as they are sheltered from the prevailing winds from the Pacific Ocean by topographic and structural elements. Retrofit work generally does not alter the building envelope; therefore no change in wind patterns or velocities is expected as a direct result of any of the alternatives. Given the existing climatic conditions and the generally low-scale height limits permitted by zoning in these areas, development which might be indirectly induced by one or more of the alternatives through demolition and new construction would be consistent with existing height controls and generally would be unlikely to cause adverse wind acceleration. Specific future development proposed which would potentially cause wind impacts would be evaluated and mitigated on a case-by-case basis at that time.

Areas in which UMBs are concentrated are among those in San Francisco that are generally sunnier and not as subject to frequent summer fog cover. However, the amenities of the built environment are limited and open space is relatively scarce. The Open Space Element of the Master Plan identifies these areas as having a high need for open space. These neighborhoods are the more

densely populated, older areas of the city where low-income, minority group populations are concentrated, where there are large numbers of young and elderly, and where people have less mobility and financial resources to seek recreation outside of their neighborhood.

Sun shading impacts from any new development that might be induced by the UMB program alternatives cannot be precisely estimated in the absence of specific proposals on specific sites. However, substantial widespread new shadow impacts due to project-associated construction would be unlikely because present UMB heights generally conform to existing height limits in the areas where UMBs are concentrated. Shadow effects would be evaluated on a case-by-case basis, based on individual development proposals.

The alternatives would not induce development that would inherently result in obstruction of scenic views or vistas, encroachment on open space, or substantial negative aesthetic impacts. Similarly, the project would not specifically promote uses which are likely to cause substantial light or glare. Individual projects that could have such effects would be subject to environmental review at such time they may be proposed.

3) Population - Could the project:	YES	NO	DISCUSSED
*(a) Induce substantial growth or concentration of population?		X	X
*(b) Displace a large number of people (involving either housing or employment)?	X		X
(c) Create a substantial demand for additional housing in San Francisco, or substantially reduce the housing supply?	X		X

Growth inducing influences will be examined in the EIR, although current and proposed zoning requirements in most affected areas discourage changes in use and density increases with their attendant growth. Citywide, substantial program-associated growth is not expected, although some redistribution of population across neighborhoods could occur.

Under certain alternatives, commercial and residential occupants may have to relocate (depending on building characteristics) for up to six months (perhaps more for alternative E). The extent to which short-term relocations might actually lead to permanent relocation of businesses and residents will be estimated and the potential to effectively mitigate occupant disruption and short-term and permanent relocation will also be described based on information obtained in discussions with relevant City of Los Angeles staff who are familiar with these impacts.

Review of available data indicates that it is primarily rental (not owner-occupied) housing that would be potentially affected by an earthquake hazard reduction program in UMBs. Relatively few UMBs appear to be owner-occupied residential units. Demand for rental housing in San Francisco of all types and prices has been high and these conditions may be expected to continue into the future. At the same time there is a shortfall of housing supply that is especially acute for low-cost and affordable rental units which comprise much of the 27,000 units located in the UMB building stock.

Consequently, any substantive obligations imposed on owners of UMBs containing residential units could inadvertently exacerbate the current housing shortage. Potential effects on housing -- including temporary relocation as necessary -- will therefore be assessed in the UMB studies with emphasis on the respective neighborhoods in which the UMBs are concentrated.

4) Transportation/Circulation Could the project:	YES	NO	DISCUSSED
*(a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system?	X	___	X
(b) Interfere with existing transportation systems, causing substantial alterations to circulation patterns or major traffic hazards?	___	X	___
(c) Cause a substantial increase in transit demand which cannot be accommodated by existing or proposed transit capacity?	X	___	X
(d) Cause a substantial increase in parking demand which cannot be accommodated by existing parking facilities?	___	X	___

Shifts in transportation and parking demands may commensurately accompany changes in land use and population distribution that may be associated with UMB Program adoption. These topics will be addressed in the EIR.

5) Noise - Could the project:	YES	NO	DISCUSSED
*(a) Increase substantially the ambient noise levels for adjoining areas?	___	X	X
(b) Violate Title 24 Noise Insulation Standards, if applicable?	___	X	X
(c) Be substantially impacted by existing noise levels?	___	X	X

For most UMBs, required retrofit work would be limited to interior work--akin to remodeling activities. Associated noise would be less than new construction noise and would occur over a shorter period of time (a few months). Retrofit related noise at specific sites would be temporary. The collective effects of a number of buildings under construction simultaneously may make construction noise a temporary problem at specific locations. Potential effects to occupants who remain onsite during retrofit work will also be discussed in the EIR.

To the extent that a UMB retrofit requirement may cause building demolitions and new construction in the study area, such activities would temporarily raise noise levels on a site-specific basis. Typical construction noise levels range from about 85 dBA to 90 dBA at a distance of 50 ft. This is loud enough to raise interior noise levels (with windows closed) to 60 dBA or greater in buildings within 150 ft. (about one-half block) of the construction site. These noise levels require raising one's voice to be heard, and are disruptive to concentration and work efficiency.

Impacts of construction noise on surrounding land uses would be controlled by the San Francisco Noise Ordinance (Chapter 29 of the City administrative Code). Multi-family residential units impacted by surrounding noise levels

would be protected by the California State-mandated Title 24 noise insulation standards. The Environmental Protection Element of the City's Master Plan has established guidelines for compatibility of land uses with the surrounding noise levels. Consistent with the Master Plan guidelines, any proposed new project that could result from implementation of an alternative could be subject to additional noise mitigation measures or project disapproval. These decisions would be made during a project-specific environmental review and/or project permit process, if applicable.

6) Air Quality/Climate - Could the project:	YES	NO	DISCUSSED
*(a) Violate any ambient air quality standards or contribute substantially to an existing or projected air quality violation?	X		X
*(b) Expose sensitive receptors to substantial pollutant concentrations?	X		X
(c) Permeate its vicinity with objectionable odors?		X	
(d) Alter wind, moisture or temperature (including sun shading effects) so as to substantially affect public areas, or change the climate either in the community or region?		X	

The EIR will examine the potential for minimizing temporary relocation of occupants during retrofit work. In the event occupants could feasibly remain in place, they may be temporarily exposed to high levels of fine dust. For many occupants-especially older and younger persons--this fine dust exposure could exacerbate health problems, and will be discussed in the EIR.

As was previously discussed for land use, current zoning (quite recently adopted in most affected areas) would serve to discourage substantial demolition and new construction in response to a UMB retrofit requirement. However, limited indirect UMB program-induced new construction could occur and such activities would temporarily affect air quality in the immediate vicinity. The PM_{10} standards related to fugitive dust are regularly violated in San Francisco. This exceedence could be exacerbated in some cases. Consequently, UMB program-related new construction air quality effects will be discussed in the EIR.

7) Utilities/Public Services	YES	NO	DISCUSSED
*(a) Breach published national, state or local standards relating to solid waste or litter control?		X	X
(b) Extend a sewer trunk line with capacity to serve new development?		X	
(c) Substantially increase demand for schools, recreation or other public facilities?		X	X
(d) Require major expansion of power, water, or communications facilities?		X	

The project is not expected to result in notable growth in the City, although some population redistribution could occur, as will be discussed in the EIR. Consequently, the project would not cause substantial increase in demand for schools, sewer, recreation, water or other public facilities. An exception may be health and social service programs for homeless persons.

Program alternatives may induce a reduction in low cost residential units. A reduction in the low cost housing stock could result in an increase in homeless persons. This chain of effects will be assessed in the EIR.

Certain program alternatives have the potential to increase the rate of building demolition that, in turn, could inflate the demand rate for disposal of large quantities of solid wastes. Demolition potential (and, if warranted by the numbers, solid waste disposal) will be assessed in the EIR.

8) Biology - Could the project:			
*(a) Substantially affect a rare or endangered species of animal or plant or the habitat of the species?	___	X	X
*(b) Substantially diminish habitat for fish, wildlife or plants, or interfere substantially with the movement of any resident or migrator fish or wildlife species?	___	X	X
(c) Require removal of substantial numbers of mature, scenic trees?	___	X	X

The UMBs are located within the developed urban area and comprise built-upon land. No Endangered (or otherwise legislatively protected) plant or animal species are known to inhabit the study area, nor are there any major stands of trees that would be affected.

9) Geology/Topography - Could the project:	YES	NO	DISCUSSED
*(a) Expose people or structures to major geologic hazards (slides, subsidence, erosion and liquefaction).	X	___	X
(b) Change substantially the topography or any unique geologic or physical features of the sites?	___	X	___

The study area is susceptible to large-scale, earthquake-induced hazards. These hazards and an assessment of impacts related to them and their reduction will be featured in the EIR.

10) Water - Could the project:	YES	NO	DISCUSSED
*(a) Substantially degrade water quality, or contaminate a public water supply?	___	X	X
*(b) Substantially degrade or deplete ground water resources, or interfere substantially with ground water recharge?	___	X	___
*(c) Cause substantial flooding, erosion or siltation?	___	X	X

The alternatives would have no effect on storm water run-off or public water supply. The project would not cause flooding, erosion or siltation, nor is any increase in exposure of persons or property expected for tsunami run ups or seiches.

11) Energy/Natural Resources - Could the project:	YES	NO	DISCUSSED
*(a) Encourage activities which result in the use of large amounts of fuel, water, or energy or use these in a wasteful manner?	___	X	X
(b) Have a substantial effect on the potential use, extraction, or depletion of a natural resource?	___	X	X

Additional energy could be used for program-induced construction; however, any replacement buildings would be built to modern, energy efficient standards. Therefore, in the long run, energy used during construction would be balanced (and exceeded) through energy savings during operation.

12) Hazards - Could the project:	YES	NO	DISCUSSED
*(a) Create a potential public health hazard or involve the use, production or disposal of materials which pose a hazard to people or animal or plant populations in the area affected?		X	X
(b) Interfere with emergency response plans or emergency evacuation plans?	X		X
(c) Create a potentially substantial fire hazard?	X		X

The extent to which existing UMBs contain asbestos that could be disturbed during strengthening activities or program induced demolitions is not known. However, existing laws and regulations that apply to asbestos disturbance, handling and disposal contain numerous safeguards to protect both workers that may be exposed and the surrounding uses at nearby locations.

The Bay Area Air Quality Management District (BAAQMD) is the agency in this region responsible for inspection and enforcement of proper hazardous waste removal and disposal of asbestos. BAAQMD, the local agency, is vested by the California legislature with authority to regulate airborne pollutants, through both inspection and enforcement, and is to be notified 10 days in advance of any proposed renovation or demolition. Regulatory prescriptions contained in BAAQMD's Regulation 11, Rule 2, Section 303 are detailed, rigorous and must be implemented by contractors that are certified by the Contractors Licensing Board of the State of California. Asbestos removal contractors are specialists and are experienced in all phases of handling the substance.

The federal Occupational Safety and Health Administration (OSHA) regulations govern worker safety and general working conditions (Asbestos Regulations 29 CFR 1910.1001. In areas where there are hazardous materials the premises must be posted in advance of the removal operation. OSHA prescribes work place standards. In making the work place safe for those closest to the hazard, OSHA requirements also protect residents and workers located further from the asbestos in the surrounding area. Consequently, no significant impacts due to asbestos disturbance are anticipated.

The program alternatives would not increase exposure of the public to hazardous materials. First, structural strengthening activities are not expected to require soils disturbance, therefore it would be only in cases of indirect, project-induced demolition/new construction that exposure may be possible. Secondly, the City has adopted an ordinance (Ordinance 253-86, signed by the Mayor on June 27, 1986) that requires applicants for building permits to analyze soil for hazardous wastes within specified areas that are generally located along the northeastern and eastern bay front and the southern portion of South of Market.

For projects outside the specified areas, environmental review requirements would include consideration of the need for testing, reporting on and remediation of hazardous soils conditions prior to construction.

The study alternatives would ultimately have differing levels of potential to place demands on the City's ability to implement the San Francisco Emergency Response Plan (administered by the Mayor's Office of Emergency Services) after a damaging earthquake. Such potential, as well as any changes in exposure to earthquake-induced fire, will be discussed in the geologic hazards section of the EIR.

13) Cultural - Could the project:	YES	NO	DISCUSSED
*(a) Disrupt or adversely affect a prehistoric or historic archaeological site or a property of historic or cultural significance to a community or ethnic or social group; or a paleontological site except a part of scientific study?	X		X
(b) Conflict with established recreational, educational, religious or scientific uses of the area?	X		X
(c) Conflict with preservation of any buildings of City landmark quality?	X		X

Prehistoric Resources

To the extent they may be present in the study area, prehistoric materials in the urbanized study area are buried--some may be located at depths as shallow as 3 feet. Site excavation would not be necessitated by retrofit activities; however, program induced demolitions/new construction that could occur may be located on sites that would require excavation for foundation work. A few such projects may be exempt from environmental review and therefore would not be subject to the City's standard mitigation to protect archaeological resources. Other projects that would involve excavation below existing foundations would be subject to the following standard mitigation:

> Prior to issuance of a site permit, the project sponsor shall retain an historical archaeologist (or other qualified expert) to perform archival research and site inspection to determine the potential for discovery of cultural or historic artifacts on the project site. Results of this investigation shall be reported to the Environmental Review Officer.
>
> The Environmental Review Officer in consultation with the Secretary to the Landmarks Preservation Advisory Board and the archaeologist shall determine whether the archaeologist should instruct all excavation and foundation crews on the project site of the potential for discovery of cultural or historic artifacts, and the procedures to be followed if such artifacts are uncovered.
>
> In the event of high probability of discovery of cultural or historic artifacts, the Environmental Review Officer may require that an archaeologist be present during site excavation and record a daily log of observations. The Environmental Review Officer may also require cooperation of the project sponsor in assisting such further investigations on site as may be appropriate prior to or during project excavation, even if this results in a delay in excavation activities.

Should cultural or historic artifacts be found during project excavation, the archaeologist would assess the significance of the find, and immediately report to the Environmental Review Officer and the Secretary of the Landmarks Preservation Advisory Board. The Environmental Review Officer would then recommend specific mitigation measures, if necessary, and recommendations would be sent to the State Office of Historic Preservation. Excavation or construction which might damage the discovered cultural resources would be suspended for a maximum of four weeks to permit inspection, recommendation and retrieval, if appropriate.

This maximum of four weeks shall include any other time periods for which the Environmental Review Officer has required a delay in excavation activities.

Historic/Cultural Resources

Of the approximately 2000 UMBs under study, approximately 75 percent were built in 1915 or earlier (eight percent were built prior to 1906). Many UMBs are known to possess significant historic or architectural features and a few are already City Landmarks. To date, and based on limited survey coverage, approximately 25% percent are noted in DCP records to have at least some potential level of architectural/historical significance. Due primarily to the potential for program-related building demolition rate increases, surveys of historical significance of the UMB stock will be extended for the EIR impact assessment. The relationship between retrofit-related activities and architectural feature preservation in historic buildings will also be assessed.

Potential conflicts with established recreational, educational and religious uses will be discussed in the EIR due to the fact that more than 80 UMBs contain these uses (37 church-owned, 24 lodges, 9 private schools, 7 theatres and 5 nursing home or hospital associated UMBs).

C. OTHER	YES	NO	DISCUSSED
Require approval and/or permits from City Departments other than Department of City Planning or Bureau of Building Inspection, or from Regional, State or Federal Agencies	X		X

The Board of Supervisors will ultimately decide whether to adopt any program to reduce the earthquake-related hazard posed by the approximately 2000 privately-owned UMBs that are located in San Francisco. The Board's decision will be based on a recommendation to be formulated by the Chief Administrative Officer in conjunction with the City's UMB Task Force and Community Advisory Committee. Public hearings will be held by the Board of Supervisors prior to any decision.

Depending on the specific elements and mitigation measures that may be included in an approved program, several City departments or boards may be explicitly included in an approval process for at least some building categories. For instance the Residential Rent Stabilization Board may be involved in approving temporary residential relocation plans in some cases or the Landmarks Preservation Advisory Board may be asked to approve any exterior alteration proposed for UMBs having historical significance.

D. MITIGATION MEASURES

	YES	NO	N/A	DISCUSSED
1) If any significant effects have been identified, are there ways to mitigate them?	X			X
2) Are all mitigation measures identified above included in the project?	X			

The EIR will contain a mitigation chapter describing measures that would be, or could be, adopted to reduce all potential adverse environmental effects of the project as identified in the EIR and will also include those previously discussed in this Initial Study for wind, shadow, view obstruction, noise, energy, hazardous and toxic wastes (including asbestos), and prehistoric resources.

MANDATORY FINDINGS OF SIGNIFICANCE

	YES	NO	DISCUSSED
*1) Does the project have the potential to degrade the quality of the environment, substantially reduce habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or pre-history?		X	
*2) Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals?		X	
*3) Does the project have possible environmental effects which are individually limited, but cumulatively considerable? (Analyze in the light of past projects, other current projects, and probable future projects.)	X		X
*4) Would the project cause substantial adverse effects on human beings, either directly or indirectly?	X		X

The project could have significant effects either individually or in conjunction with cumulative impacts of other projects in the areas of land use; population distribution (through displacement) and housing; employment; geologic hazards; historic buildings; health hazards; established educational or religious uses; and fire and emergency services. Depending on the EIR assessment's findings, localized development and population growth inducement may also impact air quality, transportation, archaeological resources and urban design resources.

E. ON THE BASIS OF THIS INITIAL STUDY

___ I find the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared by the Department of City Planning.

___ I find that although the proposed project could have a significant effect on the environment, there WILL NOT be a significant effect in this case because the mitigation measures in the discussion have been included as part of the proposed project. A NEGATIVE DECLARATION will be prepared.

_X_ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

Barbara W. Sahm
BARBARA W. SAHM
Environmental Review Officer

for
DEAN L. MACRIS
Director of Planning

DATE: 12/1/89

BWS:PSD:JRH:rlj:UMB:58

APPENDIX B

"LOS ANGELES TACKLES HAZARDOUS BUILDINGS"

Excerpted from
"Strengthening Unreinforced Masonry Buildings
In Los Angeles: The Land Use and Occupancy
Impact of L.A.'s Seismic Ordinance"

by
Martha Blair Tyler and Penelope Gregory
William Spangle and Associates, Inc.
Portola Valley, CA

1990

(Presented in this EIR for general background
and informational purposes.)

LOS ANGELES TACKLES HAZARDOUS BUILDINGS

Los Angeles, the economic and cultural heart of Southern California, faces the clearest threat of a major earthquake of any large city in the country. Scientists seem convinced that the next big earthquake will be in Southern California (USGS, 1983). The 1971 San Fernando earthquake was a big eye-opener, a watershed event which spawned a series of actions to reduce the area's vulnerability. In the late 1970's, the now-collapsed Palmdale bulge spurred public interest in earthquakes exciting the scientific community with the chance to study earthquake precursors and stimulating additional instrumentation and seismic studies in the area. The U.S. Geological Survey has poured funds and scientific manpower into efforts to better define the risks (USGS, 1985) and, perhaps, reach the ability to make a true prediction.

In 1980, the Federal Emergency Management Agency released a report on the consequences of a catastrophic earthquake in Southern California concluding that the impacts would spread through the economy of the nation, if not the world (FEMA, 1980). The Southern California Earthquake Preparedness Project (SCEPP) was born soon after as a joint federal-state effort to reduce the region's vulnerability. During SCEPP's tenure, public awareness of earthquake hazards and how to prepare has increased (Turner et.al, 1986). The 1985 Mexico City earthquake struck close to home in Southern California with its large Latino population including hundreds of thousands of Mexicans. And, recently, the Whittier and Loma Prieta earthquakes provided reminders that a big one is still waiting. Science and nature seem to be collaborating beautifully at keeping a high level of public awareness of earthquake hazards in this part of California.

The City of Los Angeles has taken and continues to take steps to prepare for a major earthquake. Political leaders in Los Angeles seem to accept, at least in principle, the necessity to act to reduce earthquake losses. Councilman Hal Bernson, past chairman of the Council's Building and Safety Committee and now chairman of the Planning and Environment Committee, has become an effective and persistent advocate of reducing earthquake hazards. As a freshman councilman, he shepherded the hazardous building ordinance during the final stages of its long course from conception to adoption. The public seems to believe the earthquake threat is real, and whenever support for earthquake programs seems to waver, nature provides another, not so gentle, reminder.

THE ROAD FROM CONCEPT TO ADOPTED ORDINANCE

The history of the Los Angeles seismic ordinance is well-documented by Alesch and Petak (1986). The San Fernando earthquake placed the subject of earthquake hazards in existing buildings on the political agenda, where it stayed for the next ten years, until an ordinance was adopted. The San Fernando earthquake was moderate, only 6.6 on the Richter scale. Yet it killed 60 people, injured 2,400 and caused over $500,000,000 in property damage. Unreinforced masonry buildings again appeared as culprits as they had in earthquake after earthquake. Neighboring Long Beach had already adopted a program to require the removal or strengthening of URM's. It was Los Angeles' time to act.

Bradley Motion

The first serious move to tackle the problem of earthquake hazards in existing buildings came in February 1973 when Councilman Thomas Bradley introduced a resolution directing the Department of Building and Safety to analyze the feasibility of a program to strengthen seismically hazardous buildings. The resolution stated, "the City of Los Angeles must take steps to adopt a systematic long-term program to reduce the risk to lives by repairing such buildings, phasing them out, or converting them to low density uses" (Bradley, 1973, as quoted in Alesch and Petak, 1986).

In response, the Department of Building and Safety took on a task that evolved into study after study and draft after draft of an ordinance to abate earthquake hazards in existing buildings. The initial focus was on URM movie theaters. These numerous, high occupancy buildings were considered the worst life-safety risk in the city, and the department proposed that they be brought up to current code standards for both earthquake and fire safety. Opposition to the idea was vocal from the movie industry and theater owners in addition to the California Society of Theatre Historians. The main argument in opposition was the same one that was put forth throughout the long process of public debate--the building owners could not afford to do the work.

Seismic Safety Element

In September 1975, Los Angeles adopted the seismic safety element of its general plan as required by state planning law. The plan recognized the importance of the hazardous building problem in Los Angeles and recommended that abatement priorities be established "based on method of construction, hazard to life, occupancy, physical condition and location" (City of Los Angeles, 1975).

Buildings of Public Assembly

In 1976, the Department of Building and Safety proposed a new version of the ordinance encompassing all pre-1934 buildings with unreinforced masonry bearing walls with assembly room for 100 or more occupants. The proposed ordinance required these buildings to be brought into compliance with the current building code or demolished. The President of the Board of Building and Safety Commission wrote a letter to the City Council stating that costs of repairs would approach the cost of new construction and that, because of "redlining", most of the owners would not be able to get financing. He recommended that the council look for federal or state grants, low-interest loans, or tax incentives to relieve owners of the expected financial hardships. Coupled with the argument that owners could not afford the costs, the issue of finding financial help for them was a recurring theme in the debate over the ordinance.

Interim Posting of Buildings

While some of the financing and legal issues were being worked out, the department proposed that hazardous buildings be posted as an interim measure to be followed by repair to current code or demolition. Angry protests resulted. The posting provision was considered particularly onerous by owners of apartment buildings and commercial property.

Arnold Luster of Major Properties, a firm that sells and leases old brick industrial buildings, expressed the real estate position about posting: "Once you put out a sign, you might as well board up the building." He went on to say that insurance would be cancelled, employees would walk out and labor union members would refuse to enter (Los Angeles Times, November 25, 1979).

Howard Jarvis, who spearheaded the successful statewide campaign to adopt Proposition 13, headed a campaign called Save Our Bricks (S.O.B.) to oppose posting on behalf of the Los Angeles County Apartment Association. He was joined in protest by the Hollywood Chamber of Commerce which feared:

> ". . . demolishing them would result in substantial loss of property taxes, added welfare problems due to lost jobs, increased insurance rates, reduced potential for future sales of the buildings, and financing problems for upgrading or rebuilding the structures.", (Alesch and Petak, 1986, p. 63).

Although the ordinance including posting was favored by the Los Angeles Chamber of Commerce, Chairman of the State Historical Building Code Advisory Board, some private citizens, and the UCLA engineering faculty (Alesch and Petak, 1986), the trend seemed clear. The opposition became more organized and more vocal as the debate over the ordinance continued.

Last Push

Further study and more public meetings failed to bring about a decision. In January 1977, the City Council committee reviewing the matter made four recommendations (cited in Alesch and Petak, 1986):

1. Department of Building and Safety take two years to inventory all pre-1934 URM's except one and two family dwellings.
2. Building and Safety Committee appoint a special committee to develop a comprehensive earthquake safety ordinance for all pre-1934 buildings with URM bearing walls except 1 and 2 family dwellings.
3. Planning Department prepare a draft Environmental Impact Report (EIR).
4. City Council request financial assistance from Congressional delegation for rehabilitation.

The council authorized $81,680 for the studies. These final studies paved the way for adoption of the ordinance.

Inventory. At the time the process started, the Department of Building and Safety estimated that the city had about 14,000 pre-1934 URM buildings. A complete inventory, undertaken as directed by the council committee, showed that the original estimate was much too high. The final inventory, excluding residential buildings with 5 or fewer units, listed 7876 URM buildings categorized by use as shown in Table 2.1.

Table 2.1. URM BUILDINGS IN LOS ANGELES BY USE, 1979

Use	# Buildings	Square Feet/Units
Commercial	4,108	30,171,000 sq. ft.
Industrial	2,393	27,260,000 sq. ft.
Apartments	811	28,289 units
Hotels	268	17,333 units
Public	134	n/a
Others	162	n/a
Total	**7,876**	

[Source: Draft EIR, Los Angeles Planning Department, 1979]

Although this is a larger number of URM's than in any other city in California, it is just over 1 percent of the city's building stock of about 700,000 buildings. The city staff estimated that the commercial and industrial buildings contained 6,501 businesses employing 69,887 workers. The residential buildings with a total of 45,622 dwelling units housed as many as 137,000 people. The city's Cultural Heritage Board designated 17 of the buildings in the inventory as historical monuments and the City of Los Angeles owned 91 of the buildings including 18 fire stations and numerous other essential facilities (Los Angeles Planning Department, 1979).

Most of the URM buildings are in the older sections of Los Angeles. The apartment buildings are concentrated in Hollywood, Wilshire and Westlake and most of the commercial and industrial buildings are downtown. Figure 2.1 is a map of Los Angeles showing the city's 35 planning areas and the number of URM buildings in each. A similar map and a list of the addresses of the public buildings housing essential services and private buildings with more than 100 occupants and in use 20 or more hours per week was printed in the Los Angeles Times on November 25, 1979, two months before the ordinance was adopted (Spiegel, 1979).

Earthquake Safety Study Committee. The Building and Safety Committee appointed the Earthquake Safety Study Committee to forge an adoptable ordinance. Several significant changes emerged from the committee efforts to come up with an acceptable ordinance: a new and more accurate method of testing the strength of existing URM's, new standards for strengthening, an interim "anchor only" option for owners, and better information about the costs of reinforcement.

Testing. In 1978, three URM buildings that stood in the way of a street widening project were used by city engineers with help from the Structural Engineers Association of Southern California and students from California State University at Los Angeles to test various methods of strengthening URM buildings. An in-place shear test was developed that allowed calculation of the shear strength of a URM bearing wall very simply with the removal of a single brick. Up to then, there was no practical method to account for a building's existing strength in calculating reinforcement requirements.

Standards. With the ability to take the residual strength of the building into account and more precise information about the likely effectiveness of reinforcement methods derived from the experiments with the three buildings, compromise standards were developed based on the strength requirements of the 1955 UBC. It was found that the life-safety objective could be substantially reached without requiring full compliance with the current building code.

"Anchor Only" Option. Experiments on the buildings clarified that the threat to life could be significantly reduced by anchoring outside walls to the floors and roof and by anchoring parapets. This led to a proposal to allow building owners who installed anchors additional time to bring the building into full compliance. By installing the anchors within one year of receiving the notice, the owner could take an additional three to nine years to complete the work for full compliance, depending on the classification of the building. Otherwise, the owner was given three years from the time of notification to reach full compliance.

Costs. Tests on the three buildings found costs of $15-$20 per square foot for full compliance with the existing Uniform Building Code. In order to determine the cost effects of the new standards being proposed, the committee commissioned a consultant study of costs which was completed in May 1980 by Wheeler and Gray, Consulting Engineers. Estimates of total project costs including engineering, testing and building permit fees, ranged from $6.22 a square foot for a four-story apartment building to $12.08 for a building with apartments over industrial space. The apartment building, with fewer large openings in bearing walls and more interior walls, cost less than the commercial or industrial buildings. The average cost was $8.60 per square foot. Reinforcement costs to bring a building into compliance with the current UBC standards were about 70 percent of the replacement cost of the building. However, with the new standards, reinforcement costs were estimated to be only 20 percent of the replacement cost.

Draft EIR. The Draft EIR was circulated by the Planning Department in September 1979 and certified on December 10, 1980. By today's standards it is a slim document with limited analysis. But it did cover the main points -- the ones that dominated the political discussion throughout the process: tenant displacement, loss of affordable housing, and disruption of businesses. The Draft EIR identifies the loss of housing for senior citizens and low-income households and business failures caused by rent increases and demolitions as unavoidable adverse impacts.

The Draft EIR argues that these adverse impacts are offset by the beneficial impact of saving lives, injuries and property loss in the event of an earthquake. It estimates the seismic ordinance could save 8,500 lives, prevent 34,000 casualties, and avert hundreds of millions of dollars in property loss. These savings would result in a significantly reduced need for disaster assistance following an earthquake. The ordinance is also noted as leading to removal of "structural eyesores" and generating much-needed redevelopment, particularly in the Central Business District. The EIR concluded that the beneficial impacts outweighed the adverse ones.

Assistance to Owners and Tenants. Good intentions did not lead to a program of assistance to owners and tenants. The passage of Proposition 13 in 1978 virtually eliminated the possibility of substantial assistance from the city. New initiatives were not

forthcoming from either the federal or state government. Public funding programs were being cut; not expanded. However, in the end, the City Council acted on the ordinance without resolving the issue of financial assistance to owners or tenants.

Adoption

By late 1980, the final round of studies had been completed. An essentially new ordinance was before the City Council. It incorporated new, less stringent standards and options which allowed owners to spread the costs over a longer period of time. The studies also indicated that costs would not be as high as feared. The EIR concluded that the benefits easily outweighed the adverse impacts of implementing the proposed ordinance. The issue of financial assistance for owners and tenants was put aside. Following three more long public meetings in late 1980 and early 1981, the City of Los Angeles adopted what is now referred to as its "seismic ordinance" on January 7, 1981.

DIVISION 88--THE SEISMIC ORDINANCE

Division 88 entitled "Earthquake Hazard Reduction in Existing Buildings" is commonly referred to in Los Angeles as the "seismic ordinance". It was originally adopted as Division 68 of the Los Angeles Building Code, but is now encoded as Division 88. The purpose of the ordinance is to reduce "the risk of death and or injury that may result from the effects of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934." (Sec. 91.8801.1). It applies to all municipal and private URM buildings constructed prior to October 6, 1933, except detached one- or two-family houses or apartment buildings with fewer than five units.

Classification of Buildings

Each building is classified by risk. With the exception of essential buildings, risk is determined primarily by the building's occupant load as follows:

I	Essential Building	Hospitals, fire/police stations, EOC's
II	High-risk Building	100 or more occupants, no masonry or wood-frame cross walls, used more than 20 hours per week, and not in I
III	Medium-risk Building	More than 20 occupants; not in I or II
IV	Low-risk Building	Fewer than 20 occupants

[Source: Table No. 88-A Rating Classifications, Table No. 88-C Service Priorities and Extended Time Provisions and Section 91.8803 Definitions.]

Orders

The Department of Building and Safety initiates the process by sending an order to comply with the seismic ordinance to the owner of a building on the list. All essential buildings were noticed immediately. Then, the orders were sent to owners of high risk buildings, then medium risk, and finally to the owners of low-risk buildings on a schedule calculated from the time the ordinance was passed as follows:

Risk Classification	Occupant Load	Minimum Time to Serve Order
II	100 or more	90 days
III	100 or more	1 year
	51 to 99	2 years
	20 to 50	3 years
IV	fewer than 20	4 years

[Source: Table No. 88-C. Service Priorities and Extended Time Periods]

The written order is served to the property owner and the person in charge of the building in person or by certified or registered mail. The order notifies the owner that his building is subject to Division 88, gives the rating classification and contains the alternatives and time limits for compliance. An owner may appeal the order to the Board of Building and Safety Commissioners.

Once the order is served, that fact is filed with the Office of County Recorder. If the building is demolished, found not to be within the scope of Division 88 or brought into compliance with Division 88, the Department of Building and Safety certifies the change of status to the Office of County Recorder. If an owner fails to comply with the standards or time limits of Division 88, the Department of Building and Safety must order the building vacated until it is brought into compliance. If the owner still does not comply, the Department's Building Superintendent may order demolition of the building at the owner's expense.

The times are minimums and, at the beginning of the program, the city was taking longer to send out orders. After the September 1985 Mexico City earthquake, the City Council directed staff to accelerate the program and set 1992 as a target date for completion. The last orders for the Class IV buildings were sent out in early 1988--7 years after adoption of the ordinance.

Options and Time Limits for Complying

After the owner of a URM has received an order to comply from the city, he must obtain a structural analysis of the building by a civil or structural engineer or an architect licensed by California. If the building does not meet the structural requirements of this ordinance, the owner must modify it to conform to the requirements or demolish it. He has the choice of completing the work in one phase (option 1) taking a maximum of three years, or two phases (option 2) taking a maximum of four years from the time he is served with the order to comply. The options are:

Option 1 (3 years). Structural analysis and, if indicated, plans for structural alterations or plans for demolition must be submitted to the Department of Building and Safety within 270 days of the order and a permit for building strengthening or demolition permit obtained within one year of the order. Work on alterations must start within 180 days of building permit issuance and be completed within 3 years of the order.

Option 2 (4 years). Plans for installation of wall anchors must be submitted to the Department of Building and Safety within 120 days of the order, a building permit obtained with 180 days, work begun within 270 days and the anchoring completed within one year of the order. The owner then has three years to complete the process as outlined in option 1.

As originally adopted, option 2 gave the owner up to seven more years to complete the work than option 1. After the Mexico City earthquake, this was shorten to one year, making option 2 much less attractive to owners than it was initially. All time limits, except for beginning construction, run from the date of the order to comply.

Historic Buildings

Division 88 does not exempt buildings which have been designated by the federal, state or city government as historic. However, special provision is made to preserve and restore original architectural elements and to strengthen adobe walls. Alternative materials, design or methods of construction can be considered to preserve historic structures undergoing strengthening. In such cases, the State Historic Building Code was intended to apply. However, strict interpretation of Division 88 by building officials does not allow much flexibility for changes to preserve historic character.

A more flexible method for meeting the life-safety objective of Division 88 was developed by Agbabian and Associates, J. Barnes and Associates and Kariotis and Associates (ABK). This method, called the Rule of General Application (RGA), is accepted by Building and Safety as an alternative to the method set forth in Division 88. It allows engineers to consider the strength of existing cross walls and diaphragms in calculating strengthening needs, and is particularly applicable to historic buildings because it helps avert undue damage to the existing structure during strengthening work.

Standards

The standards in Division 88 include lateral force requirements equivalent to about 60 to 70 percent of the 1980 Uniform Building Code. Roofs and floors must be appropriately anchored to walls and walls anchored to foundations. Materials used in construction must be able to resist seismic shaking. At least two in-place shear tests, or one every 1500 feet, are required on each wall. In addition, tests of the quality of mortar and shear bolts are required. The standards are established to prevent the total collapse of bearing walls and resultant threat to life. URM buildings strengthened to these standards are still expected to sustain significant damage in a sizable earthquake.

PRACTICALITIES OF IMPLEMENTATION

With the adoption of the seismic ordinance, the City of Los Angeles mandated the upgrading or removal of almost 8,000 buildings in about 15 years. No U.S. city has ever taken on a comparable task. The closest parallels stem from the heyday of slum clearance and urban renewal projects in the 1950's, but even the most ambitious renewal projects rarely affected over a few hundred buildings. As Los Angeles moved into implementing the program, many of the concerns that were raised during the long debate over adoption of the seismic ordinance became the concerns in implementing it. The overwhelming issue was

the cost -- how much it would be, who would bear it, and how much help would be available to meet it.

Costs of Strengthening

How much does it cost to reinforce a building? Many studies have been conducted to answer this perennial question and the answer is still, "It depends." Buildings are nearly as unique as human beings, making generalizations risky. The 1980 Wheeler and Gray study, cited above, found a cost range from $6.22 to $10.60 per square foot including engineering, testing, permit fees and construction. The average cost was $8.60.

The Department of Building and Safety did a study indicating that it cost $100 to $150 for each wall anchor and about $250 for each parapet anchor. To remove the roof and add plywood cost about $3.10 per square foot and full compliance cost $3.50 to $10.00 with the average $6.50 per square foot (Alesch and Petak, 1986).

In 1988, the engineering firm of Englekirk and Hart undertook a study for the Federal Emergency Management Agency to determine the costs of seismic rehabilitation of several types of existing buildings including URM's. The study included a sample of 137 buildings in Los Angeles. The typical cost per square foot to strengthen was $6.40 with a low of $4.20 and a high of $10.00. The low and high figures exclude the top and bottom one-sixth of the sample. The figures do not include patching and repainting which can amount to ten percent of the cost of the seismic work (FEMA, 1988).

The costs from the Los Angeles buildings in the Englekirk and Hart study sample were by far the lowest costs found. Strengthening URM buildings in Long Beach and in other cities cost much more, as did strengthening non-URM buildings. According to the study, different ordinance standards account for the cost differences between Long Beach and Los Angeles. Another reason the costs were lower in Los Angeles is the prevalence of non-union labor. The minimum hourly wage for union labor is about $18.00; non-union labor can be as low as $6.00 an hour (FEMA, 1988). It has also been argued that costs are going down in Los Angeles because contractors and engineers are becoming more adept at seismic rehabilitation (Alesch and Petak, 1986). In fact, a few contractors are doing the majority of the work.

The Englekirk and Hart study also found that costs per square foot were generally higher for residential buildings than for commercial buildings, but this difference seems to be more a function of height and building area than of use. Most of the residential URM's are multi-story buildings and many of the URM commercial buildings are single story. Others, however, have concluded that costs per square foot are lower for big buildings than for small buildings and that commercial buildings are generally more costly to strengthen than residential buildings because of larger wall openings for doors and windows and lack of interior walls (Deppe, personal communication, March 1989). It is not clear how the use and size of buildings affect cost.

In a more recent study done for the Community Development Department (CDD), Mary Comerio reviewed the construction documents for 15 strengthened three- and four-story apartment buildings and found a cost range from $7 to $12 per square foot. Eleven of the buildings in the study were rehabilitated with funds from CDD and, as required by the

Davis-Bacon Act, union wages were paid for the work. A high percentage of the work on CDD-funded buildings was for non-seismic upgrades. Comerio observes that the costs are going up now as the demand for engineers and contractors is exceeding availability (Comerio, 1989).

Other Costs

The strengthening costs are only part of the story. Most of the URM buildings are also on the city's "Dorothy Mae" list of buildings with fire safety violations. In residential buildings, it can cost an additional $1,000 per unit to meet the fire safety requirements (Zeidman, 1988). The "patching and repainting" needed to make the building habitable after seismic work has been done can be extensive, including new roofs, new flooring or resurfaced walls.

Owners may choose to add modern wiring, plumbing and heating at the time of seismic work as part of general remodeling. The Comerio study found that more than half the costs of residential rehabilitation projects receiving funds from CDD involved non-seismic renovation. This adds substantially to the cost of the project and is most likely to be done when the building is located in an area that commands higher rents. Also, if conventional bank loans are sought to do the work, financing costs can be an important element of total project costs.

Effects on Rents

The construction costs are initially paid by the building owner. In most cases, however, owners expect or attempt to recover these costs from rents. The ability to do this depends on the rental market in the building's neighborhood. If the market supports higher rents, the costs will be passed on to business or residential tenants. Where the market does not support higher rents, the owner will bear most of the costs. In the latter case, demolition is a more likely choice.

A major issue has been the effect of the seismic ordinance on rents in residential buildings. URM buildings provide about six percent of Los Angeles' housing and about 20 percent of its affordable housing (Zeidman, 1986). The URM apartment buildings and residential hotels are a critical source of housing for low- and moderate-income households in the city. An increase in rents can effectively evict tenants who have little or no chance of finding other affordable housing.

The Los Angeles rent stabilization program, administered by the Community Development Department (CDD), regulates rents on about 490,000 units covering about 80 percent of the city's rental stock. Most apartments, condominiums, duplexes, mobile homes, hotel and guest rooms are subject to the regulations. Single-family homes, certain "luxury" units built after 1978, and units undergoing "substantial" renovation are not covered, and no controls pertain to rent increases at the time of a voluntary change in tenants. Owners can apply for rent increases to recover the costs of seismic rehabilitation over a five year period. In 1988, the average of all rent increases approved for seismic work (including interest) was $64 a month; the average for seismic work, Dorothy Mae compliance, other capital improvements, and interest was $72 a month (Comerio, 1989).

Relocation Assistance

In the early years of the program, owners were exempt from relocation payments to tenants displaced because of the mandated seismic work. This was changed in 1986 and since then, tenants evicted for major rehabilitation work or demolition are eligible for relocation assistance. Owners must pay $5,000 per unit for tenants who are elderly or handicapped or responsible for a dependent child and $2,000 per unit to other tenants. The payments represent a significant cost to owners of residential buildings and may be helping to deter demolitions and evictions while the seismic work is being done. But keeping tenants in place during the seismic work adds to the time and cost to do the work. The building owner often faces a difficult choice.

Moratoria

Since 1987, the Los Angeles City Council has adopted several moratoria for various periods of time to prevent owners of residential URM's from evicting tenants, raising rents or demolishing buildings. The issue is always the lack of suitable and affordable replacement housing and the main target has been single-room occupancy hotels (SRO's), the city's housing of last resort. A moratorium on demolishing SRO's is currently in effect and the City Council is considering expanding it to include all residential URM's (Deppe, personal communication, October 31, 1989).

Government Assistance

The Los Angeles program started in the early Proposition 13 days when funds for local government were at a low point and means of financing normal and mandated governmental operations were stretched to the limit. The City Council adopted the seismic ordinance with the hope that state and federal funds normally available for housing programs could be used to ease the impacts on owners and tenants, particularly of residential buildings. Unfortunately, the need came at a time when funding for federal housing programs was being slashed. Nor were funds coming from the state. The Los Angeles program got underway with no coordinated program to assist owners with the costs of strengthening or tenants with impacts of displacement.

As the program evolved, the Los Angeles Community Redevelopment Agency and Community Development Department used available funds to assist owners of residential buildings and help displaced tenants. For the most part, owners of commercial buildings and business tenants have borne the costs of complying with almost no public assistance. Because using public assistance means using union labor for the work, even the little public funding available has not been popular with building owners. The higher labor cost can eliminate any real financial advantage.

In 1984, the California Legislature authorized $200,000,000 in tax exempt revenue bonds to finance seismic rehabilitation statewide. Because of restrictions in the use of the funds and high front-end costs, only two seismic projects in Los Angeles had been financed this way as of 1985 (FEMA, 1988). Last year, California voters approved a general obligation bond of $80,000,000 to help finance seismic strengthening of existing buildings. These funds are available to cities and counties in the state on a first come/first served basis.

A similar bond issue on the Los Angeles ballot in April 1989 just missed getting the two-thirds vote required for passage, and the city may place the measure on the ballot again. The city exempts seismic work from reassessments for property taxes and is also considering establishing a special assessment district to raise funds for low-interest loans to help URM owners.

Some building owners have taken advantage of a 20 percent federal tax credit for rehabilitation of designated historic buildings or buildings which contribute to the character of a designated historic district. The work must be done according to Standards for the Rehabilitation of Historic Buildings issued by the Secretary of Interior. There is also a 10 percent federal tax credit for rehabilitation of buildings constructed prior to 1936.

The Englekirk and Hart study contains a detailed account of these and various other public funding mechanisms and programs available to assist owners and tenants with the program (FEMA, 1988). Another good source of information about options for financial assistance is a report by David Prowler compiled for San Francisco (Prowler, 1988). Efforts continue to find funding to assist with seismic strengthening, but so far, most of the costs have been borne by the private sector.

ROLES OF CITY DEPARTMENTS

The Los Angeles program to reduce earthquake hazards in URM buildings has the potential to affect many aspects of the city, including the safety of thousands of residents and workers, the city's physical development, the economic well-being of large numbers of residents and businesses, the social fabric of neighborhoods, and the city's architectural and historic heritage. Several agencies within Los Angeles city government have roles in carrying out the program. The most important are the Department of Building and Safety, the Community Development Department and the Community Redevelopment Agency. Each has responded to the problems that arose within its normal scope of activities. Despite the fact that the roles are obviously interdependent, no formal mechanism for interagency coordination was established.

Department of Building and Safety

From the outset, the Department of Building and Safety has been in charge of the program, forming the Division of Earthquake Safety to administer it. The Department is responsible to the City Council for meeting the deadlines established in the ordinance, maintaining the records, sending the orders, reviewing and approving the plans, and inspecting the construction. The staff deals on a daily basis with owners, engineers, and contractors.

The decision to accelerate the program after the Mexico City earthquake created an administrative logjam. The Earthquake Safety Division staff was too small to handle the paperwork and oversee the work in the field. In an effort to keep up, the Department added inspectors and plan checkers. By October 1989, the Division had a staff of 75, including 43 building inspectors, 23 engineers and plan checkers, and 9 secretaries and clerks (Deppe, October 31, 1989, personal communication).

The Department's task has a strong single purpose--to avert unnecessary loss of life in the

next earthquake from the failure of URM's. The focus, which is inherent in the priorities based on building classification and the Department's normal mission, is on buildings rather than people or neighborhoods. Maintaining this focus has been essential to the program's substantial progress. Although the department works with the owners and tenants of URM buildings on a regular basis as it carries out the program, it has needed the help of other city departments to deal with the human, economic and neighborhood impacts of the program.

Community Development Department (CDD)

The Community Development Department oversees the use of Community Development Block Grant funds which Los Angeles receives from the U.S. Department of Housing and Urban Development (HUD). The funds must be used for projects that benefit low- and moderate-income people. The agency also administers the city's housing programs and rent stabilization program, acting as a tenant advocate within city government. Preserving housing available to low-income households is the Department's primary objective.

CDD allocates funds to help owners of URM residential buildings finance strengthening projects. For example, in 1987 CDD, using a combination of Block Grant funds and bond financing, allocated about $29,000,000 in grants for seismic strengthening and renovation of 27 residential buildings containing a total of 1,225 units. The total cost of the 27 projects, most of which were in the Westlake and Hollywood planning areas, was about $33,000,000; the building owners paid about $4,000,000 out-of-pocket for the work.

CDD has taken a strong position against the demolition of affordable housing and has successfully lobbied the City Council for various moratoria to prevent owners of residential URM's from evicting tenants, raising rents or demolishing buildings, particularly SRO's. The agency also regulates rent increases for strengthened residential buildings. As URM residential buildings are strengthened, owners can apply to CDD for rent increases based on documented costs. Rents are set to permit owners to recover the costs in five years.

Community Redevelopment Agency (CRA)

CRA is an independent agency with its own Board of Directors, created to oversee redevelopment in Los Angeles under authority granted by the California Community Development Law. It can use tax increments from new development in established redevelopment areas to finance public improvements and undertake various other programs. Under state law, 20 percent of the tax increment from a redevelopment area must go toward affordable housing. In the designated project areas, CRA reviews all development applications, including applications for seismic work. Through its review process, the agency has acted to safeguard historic buildings in downtown Los Angeles and Hollywood.

About 300 residential URM's are located within the various redevelopment areas. CRA has declared a three mile radius around the Bunker Hill Redevelopment project in downtown Los Angeles as an "area of benefit" for the use of housing trust funds from the successful project. Some of those funds, plus funds from tax exempt bonds and from HUD's Section 312 housing program, have been used to establish a loan program to assist owners, particularly of SRO's, meet seismic and other code requirements. In 1987, the agency was

assisting the strengthening of 50 buildings with 2,266 units at a cost of $31,878,404. Work was completed on 24 of the buildings, underway on 15, and authorized on 11. Seventeen of the buildings were SRO's located in the Central City East project area.

In 1983, the agency created the SRO Corporation, a non-profit group to acquire, rehabilitate and manage SRO's in Skidrow. The objective is to improve the safety of SRO housing units while keeping rents affordable to those on the lowest rung of the economic ladder. Several of the SRO's are URM's and CRA is pressed to complete work on these buildings, or assist owners to complete the work, in time to meet ordinance deadlines.

STATUS IN NOVEMBER, 1989

The Los Angeles URM strengthening program is less than four years from its target completion date in 1992. With refinements over the years, the building inventory now stands at 8,149 buildings. By March 1, 1989, the orders to comply had been sent out to the owners of all but 71 of the buildings on the list. Table 2.2 summarizes the status of the program as of November 1989.

Table 2.2. STATUS OF SEISMIC WORK, NOVEMBER 1, 1989

	All Buildings		Commercial		Residential Buildings		Residential Units	
Status	#	%	#	%	#	%	#	%
Strengthened	2,855	35.0	2,192	33.8	663	39.7	19,164	39.1
Demolished	1,178	14.5	1,015	15.7	163	9.8	5,591	11.4
Work Underway	1,249	15.3	919	14.2	330	19.8	10,618	21.7
Anchors Only	358	4.4	325	5.0	33	2.0	1,296	2.6
Vacated	172	2.1	161	2.5	11	0.7	330	0.7
Under Permit	940	11.5	706	10.9	234	14.0	6,721	13.7
Plans Submitted	506	6.2	389	6.0	117	7.0	3,247	6.6
No Plans	891	10.9	773	11.9	118	7.1	2,008	4.1
Total	**8,149**	**99.9**	**6,480**	**100.0**	**1,669**	**100.1**	**48,975**	**99.9**

[Source: Los Angeles Department of Building and Safety, Status of Division 88, November 1, 1989]

In the first eight years of the program, 5,282 or about 65 percent of Los Angeles' URM buildings have been demolished, strengthened or are in the process of strengthening. Of these 1,178, or about 22 percent, have been demolished. Just over 2,800 buildings remain to be done and permits have been issued or plans submitted for about half of these.

Residential buildings are being strengthened at a slightly faster rate than commercial. About 69 percent of the residential URM's containing over 72 percent of the total number of housing units have been demolished, strengthened or are in the process of strengthening.

A smaller percentage of residential than commercial buildings are being demolished. So far, the status figures do not reveal any special problems with strengthening residential buildings or any tendency toward large numbers of demolitions. The buildings most susceptible to demolition are those for which no plans have been submitted and those ordered vacated by the city. Thirteen percent of the commercial buildings, but only 7.8 percent of the residential buildings containing 4.8 percent of the housing units, are in these two categories.

At the current pace of work, most of Los Angeles' URM's will be strengthened or demolished by the 1992 target date. However, the economics of strengthening is probably marginal for many of the remaining buildings and the proportion of demolitions, particularly of commercial buildings, may increase. The fate of the SRO's is particularly problematic. The costs of compliance are high relative to the return that can be expected from the current tenants. And the tenants, by and large, cannot pay more and have almost no other options for housing. The city currently lacks sufficient affordable housing, and in that context, the loss of any affordable units is a severe burden. Public subsidies may be needed to strengthen these buildings and keep the units as low-cost housing or to provide relocation housing. Los Angeles has come a long way, but challenges still lie ahead.

WHITTIER EARTHQUAKE--THE FIRST TEST OF EFFECTIVENESS

The magnitude 5.9 earthquake that struck Whittier on October 1, 1987 provided the first real test of the effectiveness of Division 88. The moderate earthquake produced only a few seconds of strong ground shaking and was centered several miles from downtown Los Angeles. At the time it struck, about 1100 URM's in Los Angeles had been brought into compliance with Division 88. One of the first questions raised concerned the effectiveness of the ordinance in reducing damage.

The objective of Division 88 is to prevent deaths and injuries from the collapse of unreinforced masonry walls, particularly bearing walls. There were no deaths or injuries and no URM walls collapsed in either strengthened or unstrengthened buildings in the Whittier earthquake. But there was significant damage in both strengthened and unstrengthened URM's.

Starting immediately after the earthquake, teams of inspectors and engineers from the Department of Building and Safety surveyed over 2,400 URM buildings in the city. The data are summarized in Table 2.3. About one-third of the 2,400 buildings were damaged, about 5 percent severely enough to be at least partially vacated. Almost 30 percent of the unstrengthened URM's were damaged as opposed to only about 20 percent of the strengthened URM's. The vacated buildings included 113 unstrengthened and partially strengthened buildings and 9 strengthened buildings which suffered partial wall collapse, wall separation from floor or roof and/or severe or extensive wall cracking. Unstrengthened buildings were about three times more likely to be vacated than strengthened buildings.

Table 2.3. PERFORMANCE OF URM BUILDINGS IN WHITTIER EARTHQUAKE

URM Buildings	Surveyed URM's	Damaged #	Damaged %	Vacated #	Vacated %
Residential	430	200	46.5	47	10.9
Commercial	1,541	381	24.7	66	4.3
Total Unstrengthened*	1,971	581	29.5	113	5.7
Residential	73	16	21.9	3	4.1
Commercial	364	69	19.0	6	1.6
Total Strengthened	437	85	19.5	9**	2.1
Residential	**503**	**216**	**42.9**	**50**	**9.9**
Commercial	**1,905**	**450**	**23.6**	**72**	**3.8**
Total All URM's	**2,408**	**666**	**27.7**	**122**	**5.1**

* Unstrengthened URM's include those with Phase 1 anchors only and partially strengthened buildings.

** All 9 were only partially vacated.

[Source: Deppe, Karl, 1988b.]

Table 2.3 indicates that residential URM's fared less well than commercial URM's in the earthquake, but benefited more than commercial URM's from strengthening. Almost 43 percent of the residential URM buildings had some damage, while only 23.6 percent of the commercial URM's were damaged. Yet, while over 46 percent of unstrengthened URM residential buildings were damaged, only 21.9 percent of strengthened URM residential buildings were damaged. The improved performance was less dramatic with commercial buildings. Almost 25 percent of unstrengthened commercial buildings were damaged as opposed to 19 percent of the strengthened commercial buildings.

The Department found that damage in fully strengthened buildings was less extensive and easier and less expensive to repair than in unstrengthened buildings. However, the Department was particularly concerned about the number of out-of-plane failures occurring in top stories, the flexing of anchored walls and in-plane cracking. In large earthquakes with longer ground shaking, walls could have collapsed. As a result of this experience, the Department reviewed the standards for strengthening and made some modifications. In particular, the regulations now require additional anchoring of walls to the roof at the corners, height to thickness ratio in URM walls of less than nine, better testing of mortar strength, and improved resistance to lateral forces.

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APPENDIX C

COMPARISON CHART OF SELECTED
LOCAL UNREINFORCED MASONRY
BUILDING HAZARD MITIGATION
PROGRAMS

COMPARISON CHART OF SELECTED LOCAL UNREINFORCED MASONRY BUILDING HAZARD MITIGATION PROGRAMS

JURISDICTION	DATE OF ADOPTION	NUMBER OF BUILDINGS	TYPE OF PROGRAM AND STANDARDS	SCHEDULE FOR ACTIONS	LOCAL INCENTIVES OR FINANCIAL ASSIST.
BELMONT	1/9/90	4 UMBs	MANDATORY ANALYSIS AND FULL REPAIR UPDATED UCBC* WITH PROVISIONS FROM THE 1988 CITY OF LOS ANGELES BLDG. CODE	ANALYSIS WITHIN 18 MONTHS; FULL REPAIR BY 2/9/95 (5 YEAR)	NONE
BRISBANE	1/8/90	4 UMBs 32 TILT-UP	MANDATORY ANALYSIS VOLUNTARY REPAIR URM; 1988 CITY OF LOS ANGELES BLDG. CODE; MANDATORY REPAIR OF TILT-UP BLDGS. AT TIME OF ADDITION OR MAJOR REMODEL USING 1973 UBC STANDARDS	ANALYSIS WITHIN 12 MONTHS FOR UMB AND LETTER OF INTENT FROM OWNER REGARDING PROPOSED SCHEDULE OF REPAIR WITHIN 3 MONTHS AFTER ANALYSIS SUBMISSION	NONE
CAMPBELL	12/6/89	11 UMBs	MANDATORY ANALYSIS AND FULL REPAIR 1985 UCBC STANDARD	ANALYSIS BY 12/31/91 REPAIR COMPLETED BY 12/31/93 (4 YEARS)	CITY REDEVELOPMENT AGENCY FUNDING TO BE USED AS AVAILABLE
EL CERRITO	12/18/89	48 UMBs	MANDATORY ANALYSIS VOLUNTARY REPAIR 1985 UCBC STANDARD	ANALYSIS w/i 12 MONTHS NO FOLLOW-UP	NONE
GILROY	11/20/89	41 UMBs	MANDATORY ANALYSIS VOLUNTERY REPAIR UPDATED UCBC WITH PROVISIONS FROM 1988 CITY OF LOS ANGELES BLDG. CODE	ANALYSIS WITHIN 2 YEARS; LETTER OF INTENT FROM OWNER REGARDING PROPOSED SCHEDULE FOR REPAIR WITHIN 3 MONTHS AFTER ANALYSIS SUBMISSION	NONE

* UCBC IS THE UNIFORM CODE FOR BUILDING CONSERVATION CONTAINING A CHAPTER WITH PROVISIONS FOR URM(UMB) REPAIRS.

JURISDICTION	DATE OF ADOPTION	NUMBER OF BUILDINGS	TYPE OF PROGRAM AND STANDARDS	SCHEDULE FOR ACTIONS	LOCAL INCENTIVES OR FINANCIAL ASSIST.
LOS GATOS	1/16/90	27 UMBs	MANDATORY ANALYSIS AND FULL REPAIR UPDATED UCBC STAND.	ANALYSIS BY 5/1/90 REPAIR PERMIT BY 3/1/91 COMPLETION BY 5/1/93	ALLOW REPLACEMENT OF DAMAGED BUILDINGS W/O PROVIDING MORE PARKING
MILPITAS	12/5/89	5 UMBs	MANDATORY ANALYSIS AND FULL REPAIR 1985 CITY OF LOS ANGELES BLDG. CODE	ANALYSIS BY 9/5/90 OBTAIN PERMIT BY 11/5/90; FINAL COMPLETION DATE IS NEGOTIABLE ON BASIS OF FINANCIAL SITUATION DUE TO SMALL NUMBER OF BLDGS.	NONE
MONTEREY	2/6/90	91 UMBs	MANDATORY ANALYSIS VOLUNTARY REPAIR 1985 CITY OF LOS ANGELES BLDG. CODE	ANALYSIS WITHIN 18 MONTHS; NO FOLLOW-UP	NONE
PALO ALTO	1/26/86	47 UMBs; 51 HIGH OCCUPANCY PRE-1976 CONSTRUCTION	MANDATORY ANALYSIS VOLUNTARY REPAIR URM - 1985 UCBC HIGH OCC. - 1973 UBC	ANALYSIS WITHIN 18 MONTHS FOR URM; LETTER OF INTENT FROM OWNER REGARDING PROPOSED SCHEDULE OF REPAIR w/i ONE YEAR AFTER ANALYSIS SUBMISSION	OWNERS WHO STRENGTHEN THEIR BUILDING MAY ADD 2500 SQ. FT OR UP TO 25% OF ORIGINAL FLOOR AREA TO THE BUILDING AND NOT PROVIDE REQUIRED AUTO PARKING SPACES.
REDWOOD CITY	12/4/89	30 UMBs	MANDATORY ANALYSIS VOLUNTARY REPAIR 1985 CITY OF LOS ANGELES BUILDING CODE	ANALYSIS WITHIN 18 MONTHS; LETTER OF INTENT FROM OWNER REGARDING PROPOSED SCHEDULE FOR REPAIR WITHIN 3 MONTHS AFTER ANALYSIS	NONE
SAN BRUNO	12/11/89	7 UMBs			
SAN CARLOS	12/6/89	12 UMBs			

JURISDICTION	DATE OF ADOPTION	NUMBER OF BUILDINGS	TYPE OF PROGRAM AND STANDARDS	SCHEDULE FOR ACTIONS	LOCAL INCENTIVES OR FINANCIAL ASSIST.
SAN LEANDRO	2/5/90	55 UMBs	MANDATORY ANALYSIS AND FULL REPAIR TO 1988 CITY OF LOS ANGELES BLDG. CODE; INCLUDES URM INFILL WALL BUILDINGS	ANALYSIS AND PLANS w/i 12 MO. OBTAIN PERMIT w/i 24 MO.; COMMENCE WORK w/i 2 YEARS OF PERMIT ISSUANCE; AND COMPLETE WORK w/i 3 YEARS OF COMMENCING WORK (7 YRS. MAX)	NONE AT PRESENT BUT A PLAN TO ASSIST WITH THE COST OF ANALYSIS IS UNDER STUDY
SAN MATEO	1/3/90	28 UMBs	MANDATORY ANALYSIS AND FULL REPAIR 1985 CITY OF LOS ANGELES BLDG. CODE	ANALYSIS WITHIN 9 MONTHS FULL REPAIR WITHIN 3 YRS. WITH FOUR OR FIVE YEAR TIME EXTENSION BASED ON RISK CLASS IF WALL ANCHORS ARE INSTALLED WITHIN FIRST TWO YEARS. (8 YRS. MAX.)	NONE
VALLEJO	1/22/90	65 UMBs	MANDATORY ANALYSIS AND WALL ANCHORS; VOLUNTARY FULL REPAIR; 1985 LOS ANGELES BLDG. CODE	ANALYSIS WITHIN 1 YEAR; INSTALL WALL ANCHORS HIGH RISK - 6 MONTHS, MED. RISK - 12 MONTHS, LOW RISK - 18 MONTHS, AFTER ANALYSIS DUE DATE (2.5 YEARS MAX.)	$40,000 PER BLDG. MAX. COMMUNITY DEVELOPMENT BLOCK GRANT LOAN FUND TO BE ESTABLISHED FOR ELIGIBLE PROPERTIES

Source: Minor modification of Russell 1990

APPENDIX D

DESCRIPTIONS OF CONSTRUCTION
ACTIVITIES USED IN RETROFIT PROJECTS

DESCRIPTIONS OF CONSTRUCTION ACTIVITIES USED IN RETROFIT PROJECTS

ACTIVITY 1: TENSION ANCHORS

The most basic activity for retrofitting UMBs is the addition of heavy-duty bolts (tension anchors) to connect the roof and floors to the walls. By connecting the walls with floors and the roof, out-of-plane wall deflections are limited and the potential for common types of failure is minimized. Several techniques are available depending on access and existing framing conditions. When a finished ceiling is present, it must either be removed during the work, or else connections can be installed from the top of each floor. In the latter case, some existing wall or floor coverings may be removed temporarily and some finish work may be needed, however, the ceiling below the work area would not be disturbed. The actual details used will depend on existing conditions as well as whether other strengthening elements are also installed.

ACTIVITY 2: SHEAR ANCHORS

Like tension anchors, shear anchors are heavy-duty bolts that are added to transfer seismic energy forces from the roof and floors to the walls. Just as tension anchors help to prevent the floors and roof from separating from the wall, shear anchors help to keep them from sliding along the wall. To install new shear anchors, access from either the top or the bottom of the floors and roof is required. The damage to existing finishes would be similar to that described above for tension anchors.

ACTIVITY 3: INTERFLOOR WALL SUPPORT (VISUALLY EXPOSED)

Unreinforced masonry walls with larger height-to-thickness (h/t) ratios are more likely to buckle out-of-plane in some earthquakes than those with smaller h/t ratios. Interfloor wall supports, often made of steel, are added to walls that have unacceptable h/t ratios. A diagonal brace connects the floor to the wall and reduces the effective height of the wall. Vertical beams are then installed to span between floors to brace the wall. These supports are often used in industrial buildings and commercial garages.

ACTIVITY 4: INTERFLOOR WALL SUPPORT (VISUALLY HIDDEN)

The interfloor wall supports described in Activity 3 are visually exposed. If this is unaccepatable for any reason, other, more expensive approaches can be employed. For instance, a steel stud wall can be used as a wall support and it will conceal the wall braces. Although a finished surface is obtained, interior space is lost. Another approach is use of a hole (core) that is drilled from the roof down the inside of the unreinforced masonry wall. A steel reinforcing bar and polyester grout are placed in the hole to increase the wall's resistance to buckling.

ACTIVITY 5: SUPPLEMENTAL VERTICAL SUPPORTS

Generally, it is the walls in a UMB that carry all or most of the vertical energy load that is produced by common gravity. When the walls fail during the horizontal loading produced by earthquakes, the buildings' structural elements that the walls support may also fail. This failure initiates a collapse or partial collapse of the roof and floors. The potential for this type of collapse can be reduced by installing additional vertical supports that are usually made of steel. To transfer the vertical energy load from the roof and floors into the ground, new foundations are sometimes required. This would involve pouring concrete inside the building.

ACTIVITY 6: ANCHOR NON-PARAPET FALLING HAZARDS

Architectural ornamentation and facings that are poorly anchored can pose a serious falling hazard to people and property below. The types of ornamentation and facing found on UMBs vary widely in San Francisco. It may be necessary to remove ornamentation or otherwise expose its support temporarily to determine whether existing anchorage is adequate or if strengthening is needed. Usually, the disruption to the interior is minimal. In San Francisco, some of this anchoring work (particularly, if needed near the roof line) is required as part of the parapet hazard abatement program previously described.

ACTIVITY 7: ROOF SHEATHING WITH NEW ROOF

The addition of a layer of new plywood roof covering increases the roof's strength and reduces its potential to move during an earthquake's horizontal energy loading. When it is difficult to apply plywood on the underside of roof framing or when the roof needs replacement for other reasons, the new plywood can be added over the existing covering. This work involves new connections to the masonry walls or, in some cases, existing connections can be modified or strengthened. The exact detail and extent of previous roof-to-wall connection work required by San Francisco's parapet hazard abatement program should be considered when adding the new roof. In some cases, a strip of new plywood around the perimeter of the roof may be adequate.

ACTIVITY 8: ROOF SHEATHING INSIDE (SOFFIT OR CEILING)

Different from Activity 7, in those cases where there is no ceiling below the roof, it may be easier and more cost effective to attach plywood to the inside face of the roof since it would then not be necessary to remove the existing roofing material. Similar to the application of plywood on top of the roof, work may also be required at the roof-wall connection.

ACTIVITY 9: ROOF CROSSBRACING OR OTHER SPECIAL SOLUTION

Some UMBs have skylights, or other large discontinuities that must be preserved. These often prevent the use of new plywood covering (Activity 8) as a method of strengthening the roof. In such cases, steel cross braces can

be used instead of plywood. Depending on the strength and configuration of the existing roof, bracing may only be needed in the end bays. The bracing can be left exposed or hidden behind a false ceiling. Regardless of the amount of bracing required, work on the roof-to-wall connection is generally also required.

ACTIVITY 10: FLOOR SHEATHING - OPEN AREA

Similar to strengthening methods for the roof, new plywood is added to the floors to increase their strength and reduce horizontal, damage causing energy forces. Generally the new plywood is placed on top of the existing plank or board covering. Floor finishes must be removed to add the plywood and then be patched or replaced.

ACTIVITY 11: FLOOR SHEATHING - EXISTING PARTITIONS

Different from Activity 10, in those cases where partitions are present, a continuous path for the transfer of forces must be provided at each wall partition bottom plate. If the partitions are not removed, new metal clips must be added at the base of the partitions to allow for transfer of forces through the partition bottom plate. Finish must be removed from the base of the partition to add the new metal clips.

ACTIVITY 12: CHORDS

Chords are horizontal frames that are added to the edges of floors and the roof to diffuse some types of seismic energy forces. The chord is often a steel angle section that can be placed above or below the floor. It is also possible to develop a chord by interconnecting existing wood elements to form a continuous energy absorber along the wall. The chord is then connected to the floors or roof, so some finishes would need to be removed and patched.

ACTIVITY 13: COLLECTORS

Collectors (or drag struts) transfer concentrated horizontal forces from floors or roofs to a vertical force resisting element such as a wall. They are often required at reentrant corners or other building configuration irregularities, and they may also be needed in other places. The collector may be made of wood or steel and usually it is added when new floor or roof strengthening elements are installed.

ACTIVITY 14: STRENGTHEN EXISTING CROSSWALLS

Certain UMBs, such as those with residential and office uses, may have a large number of internal wood stud wall partitions that typically have plaster finishes. These partition walls, called crosswalls, serve as energy-absorbing, displacement-limiting dampers when subjected to earthquake-generated horizontal energy forces. When existing partitions are used as crosswalls, they must connect floors and roofs together. Consequently, small new stud walls may be needed in ceiling and attic spaces

to make the crosswalls vertically continuous. In some cases, connections of the crosswalls to floors and roofs must be strengthened.

ACTIVITY 15: ADD PLYWOOD CROSSWALLS

In the absence of sufficient existing crosswalls, new walls (constructed of wood studs covered with plywood) can be added to absorb and displace energy forces. Any finish may be placed over the plywood; standard gypsum board is most commonly used. Code requirements are more extensive for adding new crosswalls than for strengthening existing partitions. For example, new blocking may be necessary in the floor and roof framing, connections from the crosswall to the walls, floors and roofs must have a minimum strength, and new foundations are needed.

ACTIVITY 16: STEEL MOMENT FRAME (AS A CROSSWALL)

Many multi-story buildings have open commercial spaces on the ground floor with offices or residential units on upper levels that contain many partitions. While the partitions above can be used as crosswalls, the functional requirements of the commercial first floor may prevent the addition of crosswalls. Instead, a steel frame, composed of beams and columns welded at their joints, can be used to retain the open space. Field welding of the frame components is necessary and a new foundation must be added to the frame. The second floor will also require some work to connect it to the first floor frame, and several steel angles used to brace the new steel beam may be visible after the work is completed. The frame can be faced or left exposed (if fire resistance requirements permit).

ACTIVITY 17: INFILL OPENINGS

Window and door openings can be filled to increase wall strength and reduce the stresses on the unreinforced masonry wall. The opening is filled with reinforced concrete, reinforced concrete block, or reinforced brick. To connect the new material to the existing wall, steel dowels are installed in holes drilled in the surrounding masonry. Openings are usually filled when the requirements for stress reduction are low and when the building's function and appearance make this a reasonable choice. This method is usually inappropriate for residential buildings. Infilling openings may, under some building codes, trigger the addition of automatic fire sprinklers. Code requirements that relate exterior wall openings to fire sprinklers must be incorporated in the retrofit design.

ACTIVITY 18: CONCRETE AGAINST WALL

New reinforced concrete is placed against an existing unreinforced masonry wall to increase wall strength. The new concrete is attached to the old wall with epoxy anchors and can either be cast in place with formwork or sprayed in place (called shotcrete or gunite). The thickness of the new concrete will vary with strength requirements, but usually from four to eight inches is needed. The new concrete can be placed on the inside or outside

face of the wall. When locating the wall on the inside face, the floors and roof must be cut away from the masonry wall and reattached to the new concrete. A new foundation must also be added and connected to the old foundation; poor soil conditions would require more extensive foundation work.

ACTIVITY 19: STEEL DIAGONAL BRACE

Steel diagonal braces diffuse seismic energy demands on existing masonry walls in a UMB. The braces, columns and beams can be constructed of a variety of steel shapes. It is usually necessary to add collectors and new foundations are required to transfer the forces from the braces into the ground. Bracing configurations depend on architectural, as well as structural, considerations. Due to the relative expense involved, many owners choose to leave the braces exposed to view, however, it is also possible to place them behind plaster or stud walls. They can be added either against an exterior wall or at interior locations of the building.

ACTIVITY 20: STEEL MOMENT FRAME (AS A LATERAL ELEMENT)

Many UMBs have open fronts, with many windows and entry doors on the ground floor. They lack enough existing wall to be strengthened effectively. The addition of new concrete and braced frames could be functionally restrictive for some building uses. In these situations, a steel frame may be added to increase the strength of the front face of the building. The frames may be located in a building's interior or, if space on the lot is available, they can be placed on the outside of the building.

ACTIVITY 21: INTERIOR FREESTANDING CONCRETE/MASONRY SHEAR WALL

New interior walls can be added to reduce the demand on the existing structural elements in the building. To carry forces to the new wall, collectors are usually required, and new foundations must be added. A portion of the floor must also be removed to accommode the new wall. The choice between a new interior wall and a new braced frame is constrained by compatibility with space use needs, other existing structural elements, and fire prevention requirements.

ACTIVITY 22: INTERIOR PLYWOOD SHEAR WALLS

New interior plywood walls can also be added to reduce the demand on the other building elements. There are two methods to create a plywood wall: 1) existing partitions can be stripped to allow adding plywood covering and improved connections to roofs and floors, and 2) new plywood walls can be added. In both cases finish work and limited new foundation work will be required.

APPENDIX E

MEASURES OF EARTHQUAKE
MAGNITUDE AND INTENSITY

MEASURES OF EARTHQUAKE MAGNITUDE AND INTENSITY

The following excerpt from the 1976 thesis, "Seismic Design of a High-Rise Building," prepared by Jonathan Barnett and John Canatsoulis in partial fulfillment of the requirements for the degree of Master of Science at the Worcester Polytechnic Institute, explains the Richter Magnitude scale and the Modified Mercalli Intensity scale:

"There are two important earthquake parameters of interest to the structural engineer. They are an earthquake's magnitude and its intensity. The intensity is the apparent effect of an earthquake as experienced at a specific location. The magnitude is the amount of energy released by the earthquake.

"The magnitude is the easiest of these two parameters to measure, as, unlike the intensity which can vary with location, the magnitude of a particular earthquake is a constant. The most widely used scale to measure magnitude is the Richter magnitude scale. Using this scale, the magnitude, measured in ergs, can be found from the equation Log E = 11.4 + 1.5 M, where M is the Richter magnitude. This relationship was arrived at by an analysis of the amplitude of the traces of a standard seismograph located 100 kilometers from the epicenter of an earthquake and correlating this information with the radiated energy as determined through measurements of the waves released by the earthquake. The epicenter of an earthquake is the point on the surface of the earth directly over the focus. The focus (or hypocenter) is the point in the earth's crust at which the initial rupture (slippage of masses of rock over a fault) occurs. In use, the Richter scale represents an increase by a factor of 31.6 for each unit increase in the Richter magnitude. Thus, a Richter magnitude of 6 is 31.6 times larger than Richter magnitude 5. . . .

"[A] problem with using the Richter magnitude is that it gives little indication of an earthquake's intensity. Two earthquakes of identical Richter magnitude may have widely different maximum intensities. Thus, even though an earthquake may have only one magnitude, it will have many different intensities.

"In the United States, intensity is measured according to the Modified Mercalli scale. In Europe, the most common intensity scale is the Rossi-Forel scale while in Russia a modification of the Mercalli scale is used."

"The following excerpt from Bruce A. Bolt's 1978 book, *Earthquake: A Primer* (San Francisco, California: W.H. Freeman and Company), describes the Modified Mercalli Intensity values (1956 version); masonry definitions from C.F. Richter's 1958 book, *Elementary Seismology* (San Francisco, California: W.H. Freeman and Company) are inserted in brackets:

"I. Not felt. Marginal and long-period effects of large earthquakes.

II. Felt by persons at rest, on upper floors, or favorably placed.

III. Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.

IV. Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frames creak.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.

VI. Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knick-nacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D [weak materials such as adobe, poor mortar, low standards of workmanship; weak horizontally] cracked. Small bells ring (church and school).Trees, bushes shaken visibly, or heard to rustle.

VII. Difficult to stand. Noticed by drivers. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof lines. Fall of plaster, loose bricks, stones, tiles, cornices also unbraced parapets and architectural ornaments. Some cracks in masonry C [ordinary workmanship and mortar; no extreme weaknesses like failing to tie in at corners but not reinforced or designed against horizontal forces]. Waves on ponds, water turbid with mud. Small slides and caving in along sand or gravel banks.

Large bells ring. Concrete irrigation ditches damaged.

VIII. Steering of cars affected. Damage to masonry C; partial collapse. Some damage to masonry B [good workmanship and mortar; reinforced but not designed in detail to resist lateral forces]; none to masonry A [good workmanship, mortar, and design; reinforced, especially laterally; bound together by using steel, concrete, etc.; designed to resist lateral forces]. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

IX. General panic, Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. General damage to foundations. Frame structures, if not bolted down, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in the ground. In alluviated areas, sand and mud ejected, earthquake fountains and sand craters.

X. Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.

XI. Rails bent greatly. Underground pipelines completely out of service.

XII. Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown in the air."

APPENDIX F

GLOSSARY

GLOSSARY

Beam: A horizontal structural member.

Building Function: The predominant use of a building, defined by the activities of its occupants.

Building Type: A building defined by its occupancy, such as residential or industrial.

CAO: Chief Administrative Officer.

Chord: The top or bottom portion of a beam that carries most of the tension or compression loads induced by bending. In horizontal diaphragm panels, the boundary members that resist compression or tension due to in-plane bending of the panel.

Column: A vertical structural member.

Configuration: The size and three-dimensional shape of a building.

Costs, Direct: The costs of repairing or replacing buildings or other stuctures damaged or destroyed by earthquakes.

Costs, Indirect: Costs resulting from damage to buildings, such as loss of revenue.

CPC: City Planning Commission.

DCP: Department of City Planning.

Diaphragm: A horizontal or nearly horizontal structural element designed to transmit lateral forces to the vertical elements of the seismic-resisting system, often a floor or flat roof.

Ductility: Capability of being deformed or distorted before breaking or fracturing. Contrasts with brittle.

Frame: A structural system composed of interconnecting beams and columns that provide support for vertical loads without bearing walls. Lateral resistance is provided by shear walls or braces.

Hazardous Building: A building or class of structural building type that presents a hazard to life when subjected to earthquake motion.

Infill: Insertion of material, generally masonry, within a surrounding structural frame, to create a wall.

Intensity: A qualititative measure, based on observation of effects, of the severity of seismic ground motion at a specific site (see Appendix E)

Lateral Force: Side-to-side force that pushes against a building, such as the forces created by winds or earthquakes.

Loss Estimate: An estimate of direct and/or indirect costs relating to a defined building inventory for a scenario earthquake or earthquakes.

LPAB: Landmarks Preservation Advisory Board.

Magnitude: See Appencix E, Measures of Earthquake Magnitude and Intensity.

Masonry: Includes but is not limited to brick, stone, clay tile, terra cotta, adobe and concrete block construction. Can be used for both bearing walls and nonbeari partitions.

Member: A structural element that is a single piece of a building, such as a beam, column, stud, etc.

Modified Mercalli Intensity (MMI): See Appendix E.

Moment-Resistant Frame: A structural frame in which lateral resistance is provided by special design of the joints between structural members.

NRHP: National Register of Historic Places.

Non-Ductile: Material or structural member that lacks the property of ductility.

Nonstructural: Material or component that is not designed to contribute to the vertica or lateral support of a building.

Parapet: The portion of a wall that extends above the roof line.

Partitions: Interior nonstructural walls.

Reinforced: Generally refers to concrete or masonry in which steel bars are embedded t increase its strength.

Retrofit: Repairing or strengthening an existing building to improve its seismic resistance.

Richter Magnitude: See Appendix E, Measures of Earthquake Magnitude and I.

Seismic: Of or subject to or caused by an earthquake or earth vibration.

Seismic Risk: The probability of earthquakes of specified magnitude or intensity occurring at a given location.

SFBC: San Francisco Building Code.

Shear Wall: A wall designed to diffuse earthquake energy forces in the plane of the wa

Structural: Contributing to the support of vertical loads or resistance to lateral forces.

UBC: Uniform Building Code.

UCBC: Uniform Code for Building Conservation.

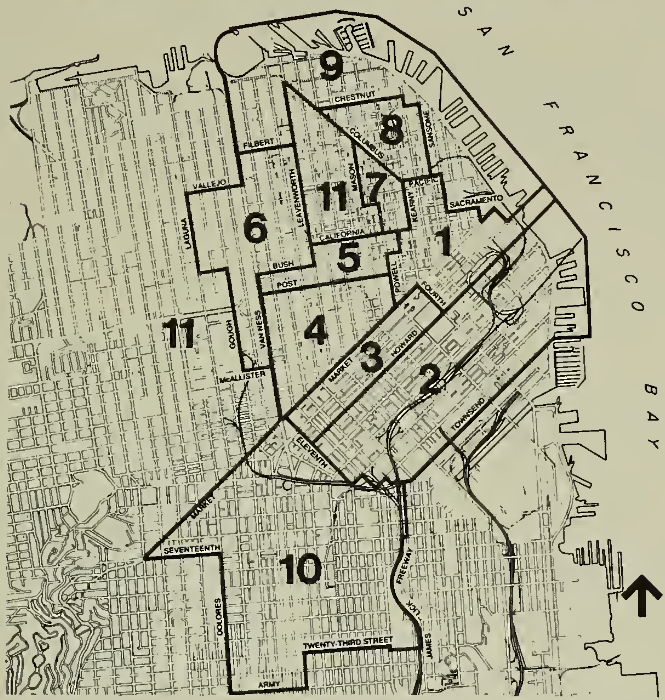
UMB: Unreinforced masonry building. Refers to a building constructed of URM.

Unreinforced: Concrete or masonry that does not have steel embedded to increase its strength.

URM: Unreinforced masonry. Refers to a type of construction.

Wall, Bearing: A wall providing support for vertical loads: it may be exterior or interior.

General Distribution Of UMBs in San Francisco



1 Downtown (343 UMBs)
2 South of Market (194 UMBs)
3 South of Market Residential (114 UMBs)
4 North of Market / Civic Center (312 UMBs)
5 Bush Street Corridor (196 UMBs)
6 Van Ness / Polk (99 UMBs)
7 Chinatown (293 UMBs)
8 North Beach (50 UMBs)
9 Waterfront (36 UMBs)
10 Mission / Upper Market (136 UMBs)
11 Outlying (234 UMBs)

Prototypes for Analysis of UMBs

Prototype	No. UMBs	Description
A	136	Small Area, One - Story (under 4000 sq. ft. plate size)
B	169	Large Area, One - Story (over 4000 sq. ft. plate size)
C	138	Irregular Shape, Residential (various plate sizes)
D	97	Irregular Shape, Non - Residential (various plate sizes)
E	89	Small Area, Industrial (under 5000 sq. ft. plate size)
F	143	Large Area, Industrial (over 5000 sq. ft. plate size)
G	236	2 & 3 Story, Small Area, Office & Commercial (under 4000 sq. ft. plate size)
H	176	2 & 3 Story, Large Area, Office & Commercial (over 4000 sq. ft. plate size)
I	70	Over 3 Story, Small Area, Office & Commercial (under 4000 sq. ft. plate size)
J	83	Over 3 Story, Large Area, Office & Commercial (over 4000 sq. ft. plate size)
K	162	2 & 3 Story, Small Area, Residential (under 2500 sq. ft. plate size)
L	147	2 & 3 Story, Large Area, Residential (over 2500 sq. ft. plate size)
M	139	Over 3 Story, Small Area, Residential (under 4000 sq. ft. plate size)
N	162	Over 3 Story, Large Area, Residential (over 4000 sq. ft. plate size)
O	60	Public Assembly - type (various plate sizes)

Building uses for the purpose of structural prototyping do not necessarily correspond with uses as classified for other types of analysis.